Nature Magazine

NOVEMBER
1959

VOLUME 52
NUMBER 9

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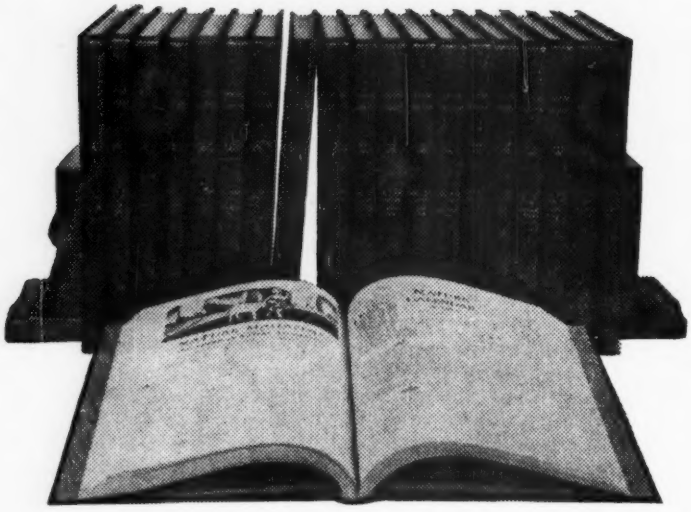

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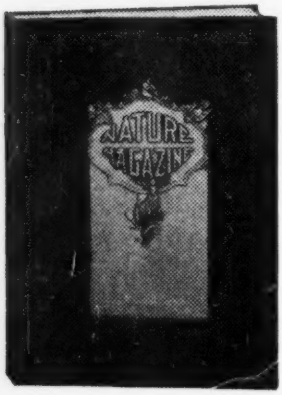

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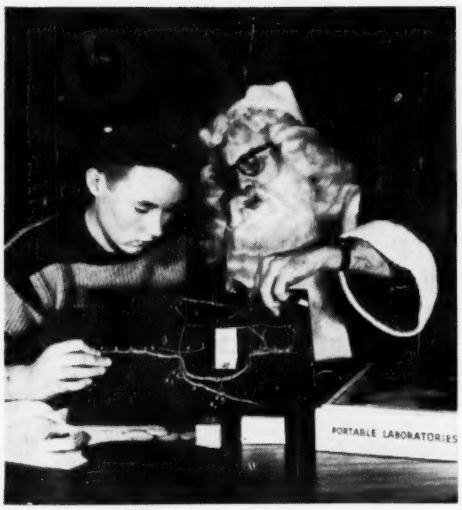

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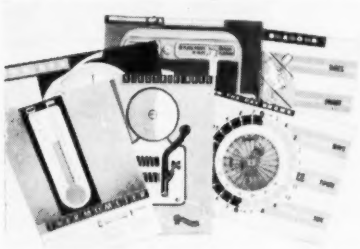

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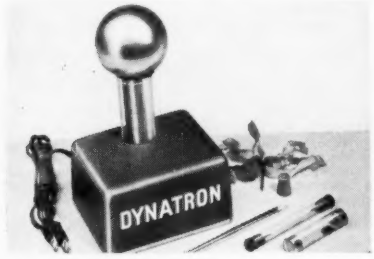

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NOVEMBER, 1959 VOL. 52 NO. 9

Published by the AMERICAN NATURE ASSOCIATION to stimulate public interest in every phase of nature and the out-of-doors, and devoted to the practical conservation of the great natural resources of America

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NATURE MAGAZINE is published monthly, October to May, inclusive, bimonthly, June to September, inclusive, by the American Nature Association. Second class postage paid at Washington, D.C., and at additional mailing offices. U.S. and Canada one year, $5; foreign, $.50 extra; two years, $9; life, $100.

Publication and Editorial Office, 1214 16th Street, N. W., Washington 6, D. C. Additional office of publication, Easton, Pa.

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Nature Magazine, past and present, is indexed in The Reader's Guide in your public library.

Reviews

Birds of the Ungava Peninsula

By Francis Harper, Lawrence, Kansas. 1958. University of Kansas Museum of Natural History. 171 pages. Illustrated. Paper-bound copies available from The Arctic Institute, 1530 P. St., N.W., Washington 5, D. C. $2.00.

Hudson and James Bays bound the Ungava Peninsula on the west, the Atlantic on the east and the St. Lawrence River and Gulf on the south. The area comprises Newfoundland, Labrador and about three-quarters of the Province of Quebec. The interior has been generally an unknown territory to biologists and, until recent years, a blank space on distributional maps of plant and animal species. Such information on the flora and fauna as existed was thanks to Henry Connolly, and his records and collecting from mid-1850 to mid-1853. A few other biologists followed, and Francis Harper began his investigations in 1953, the results of his bird studies now comprising this report.

Color Guide to Tropical Fish

By Herbert R. Axelrod and William Vorderwinkler. New York. 1959. Sterling Publishing Co. 160 pages. Illustrated completely in color from photographs by G. J. M. Timmerman and Gene Wolfsheimer. $4.50.

This is a new and revised edition of this book, first published in 1955. As the title indicates, it is a guide to the identification of tropical fish by their color rather than by genera and species. The text includes popularly presented data about the fishes and their care.

Briefly Noted

Mapping the World. By C. B. Colby. New York. 1959. Coward-McCann. 48 pages. Illustrated. $2.00. The work of the U. S. Army Corps of Engineers in mapping the world.

Full of Wonder. By Ann Kirn. New York. 1959. World Publishing Co. Illustrated by the author. $2.75. The beauty of small objects and how a youngster may enjoy them.

Before and After Dinosaurs. By Lois and Louis Darling. New York. 1959. William Morrow and Co. 95 pages. Illustrated by the authors. $2.95. The story of the five subclasses of the Class Reptilia. Told for the 10 to 14 ages.

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LIVING HIGH'S first edition went thru four printings and was hailed by the 'NEW YORK TIMES' reviewer and many others. Now a new edition with photographs, a pictorial endpaper map and a POSTSCRIPT chapter bringing the Burns' adventures up to date has been published by Wellington Books - their first book. Nicely manufactured by The Riverside Press, bound in gay yellow cloth, LIVING HIGH has 316 pages and is yours to cherish for only $3.75

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Nature IN PRINT

By HOWARD ZAHNISER

Nature Magazine Appreciated

NOVEMBER—MONTH OF THANKFULNESS AND, accordingly, a time for reminiscence, review, recapitulation — brings this year more intensively than ever a re-enjoyment of some of the most enjoyable of the offerings of *Nature Magazine* to its readers. In a volume entitled *This Is Nature: Thirty Years of the Best from Nature Magazine*, the editor, Richard W. Westwood, has presented some forty-five articles, stories, or photo-features from the magazine's back numbers, giving them thus the second blessing of selection again, the new life of book publication, and the attractiveness of immediate convenience. Its forty-four authors comprise the editor's elite of contributors, including those who, like Arthur Newton Pack, Edward Alexander Preble, E. Laurence Palmer, and Paul Mason Tilden, have been his colleagues, and the book for the readers of *Nature Magazine* becomes thus the essence of what through the years the editor has considered his best offering to them. They can rejoice and be thankful.

It was a fortunate day for American readers and the American public when *Nature Magazine* was established, and a fortunate day, indeed, when a reporter for the *Christian Science Monitor*, interviewing the magazine's publisher in Boston, found himself unexpectedly the subject of the interview and, three dozen years later, is now the reminiscent editor of this reminiscent volume.

Much of this good fortune is apparent in the book, *This Is Nature;* for here is concentrated in a collection of Nature writing the appeal of wild creatures, and of some trees and flowers likewise, to the sense of wonder and curiosity in modern men and women. Discovery, "one of the most exciting of human experiences," the editor describes as the theme of the book. At a time of "few geographical frontiers to explore," man can "always turn to nature for its myriad surprises," writes Mr. Westwood in his introduction. "He can share with the inquiring naturalist and writer the thrill of discovery of truths 'more fascinating than fiction.' " *Nature Magazine* for a generation has promoted such a sharing, and *This Is Nature* so demonstrates with a fascination that will be rewarding in either a rereading or a new experience. Its literary and editorial excellence is in keeping with the brilliance of its observations and the integrity of its interpretations. So the volume does credit to both magazine and editor.

Conservation theme

"Inherent in the selections," suggests Mr. Westwood, is the theme of conservation which "militant and independent, has been a basic tenet of the magazine" and has led to an emphasis on "knowledge and appreciation of all forms of animal life." Implicit also in many of the writings collected in this book is our human sense of a oneness with what in this volume is called Nature.

In the editor's sensitive and appreciative dedicatory quotation of Edward Preble's testimony of "The Lover of Nature" and in Mr. Preble's contribution, "The Mountain Heronry" (probably the volume's best representative selection), this sense is clearly expressed in its philosophical, pre-ecological manifestation. Arthur Carhart, in his descriptive article on the prairie dog entitled "It's a Little Dog's Life," shows some of the wistful, compassionate interest in creatures that suffer from man's enmity. Dallas Lore Sharp in his account of "A Wasatch Grizzly" declares, "All life is one," and maintains that "seen socially, all plants and birds and beasts and men and germs are somehow good." And, throughout the volume the friendly, prying, curious interest in wild creatures and plants and the enthusiasm with which writers (and of course the editor) convey to readers the exciting incidents that prove how wonderful, significant or companionable Nature is—all these are evidences of the foundations in *Nature Magazine* for its basic tenet: "Conservation—militant and independent."

It is important to recognize, however, in appraising *Nature Magazine* and the sterling public service of its publisher and editor, that its "militant and independent" conservation has been not only inherent or implicit. It has also been explicit and strikingly articulate. Through the years the editor, who has made the excellent selections represented in *This Is Nature* and has seen to their literary excellence, has also stimulated (and responded to) challenging conservation articles and has himself spoken out clearly and fearlessly in editorials that sometimes have been alone and always been in the interest of resource and public.

The waterfowl in the drought crisis of the 1930's, the wildlife sanctuaries threatened with misuse as shooting grounds, the nation's scenic landscape desecrated with billboards, national parks and wilderness areas threatened by lumbermen, dam builders, or weakening administration—all these and more have been championed valiantly by *Nature Magazine* editorially, as well as by authors welcomed to its pages.

Wilderness plea

In April of 1937, for example, it was in *Nature Magazine* that Robert Marshall published—on invitation of the editor—his classic article of the wilderness preservation movement, with its warning title "The Universe of the Wilderness is Vanishing."

"The fate of unmodified Nature rests in the activity of its friends," concluded Robert Marshall in the closing eloquence of this article. "If they continue to be too busy or too indifferent to unite in its defense, then the universe of the wilderness is doomed to early extinction. If, on the other hand, they believe that its preservation is worth the sacrifice of some precious time and energy, and if they will take the trouble to become vociferous, there is no reason why material areas of America should not be kept primitive forever."

Nature Magazine and its editor have never failed to take the trouble to become vociferous about threats to wilderness, to wildlife, to the scenic beauty of the landscape, or to

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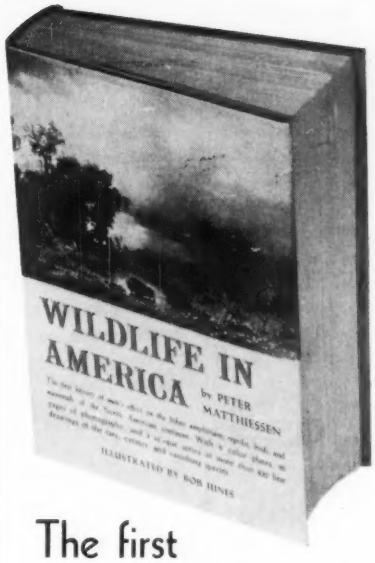
any aspect of the public interest in conservation or in what might be called the rights of nature. Playing a role unique among the periodicals issued from the Nation's capital, it has been the one outdoor monthly with general concerns speaking for the broad public interest and for Nature itself. Unlike, on the one hand, for example, *The Living Wilderness*, a quarterly with an interest in a particular aspect of conservation, or unlike *American Forests*, for another example, a monthly with broader interests and wider circulation yet speaking first of all from the viewpoint of the lumber industry and related commercial interests—unlike any other publication in the Nation's capital—*Nature Magazine* has been untrammeled and outspoken in its championship of conservation in the broad public interest.

None of this, however, is represented by the selections included in *This Is Nature*. Nor is the magazine's poetry or any of its various other special features represented. What we do have in the volume is the most appealing of the prose writings that through the years have built and maintained the magazine's readership and have thus provided both audience and backing for its service to all aspects of Nature.

The reading of this book is sheer pleasure, pleasure that would seem to be as lasting as the modern spirit of curiosity and wonder and our zest for discovery.

We can, indeed, be thankful for this book and thankful for the magazine that it represents, but we should be mindful also in our pleasure and thankfulness that this magazine with its interesting articles well chosen, well edited, well illustrated from month to month, has been a periodical notable for its much needed, dauntless service in the cause of conservation and Nature protection. This all has been *Nature Magazine*, and we salute it, its publisher, and its editor.

This Is Nature: Thirty Years of the Best from Nature Magazine. Selected and edited by Richard W. Westwood, Editor, Nature Magazine. New York: Thomas Y. Crowell Company. 1959. viii plus 214 pp. (7¼ by 10¼ in.) with 72 photographs, 21 drawings by Walter W. Ferguson, and an introduction and notes on authors by the editor. $5.95.



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Reviews

The Quest of Galileo

By Patricia Lauber. New York. 1959. Doubleday and Company. 56 pages. Illustrated by Lee J. Ames.

This large-size, splendidly illustrated and popularly presented book is the story of the great Italian pioneer scientist and the truths he sought. Although, in format and typography, this would seem to be directed mainly toward the younger reader, it should be of interest to adults as well.

100 Indoor Plants

By A. C. Muller-Idzerda. New York. 1959. Emerson Books, Inc. 114 pages. Illustrated. $2.95.

Since the original Dutch edition of this practical little book first appeared in 1937, it has enjoyed republication and this sixth edition is in English, with a foreword by Vera Higgins, British horticulturist. Besides providing information on the care and cultivation of many common indoor plants, it will introduce the average user to some kinds probably not hitherto encountered.

Ruth Potts

NOVEMBER'S AUTHORS

Ted Morello

Ted Morello, who this month takes our readers on a botanical and zoological tour of the "diggings" at the ancient city of Tikal, Guatemala, defines himself as "a newspaperman by profession and a Latin Americanist by avocation." Mr. Morello is a graduate of the University of Washington school of journalism, and has been associated with a number of newspapers in the United States, including the New York World-Telegram, where for the past ten years he has been assistant telegraph editor for national and international news. . .Norris Randolph, native of Pennsylvania, is another newspaperman with a flair for free-lance article writing, whose most recent business association has been with the Providence, Rhode Island, Journal. Mr. Randolph presently lives in East Greenwich, Rhode Island. . .Dr. Alexander F. Skutch, whose long career in the natural sciences—especially in the fields of botany and neotropical ornithology—occupies ten lines in American Men of Science, has many times been a contributor to Nature Magazine. Dr. Skutch was born in Baltimore, Maryland, and currently makes his home in Costa Rica. . . Hazel Mohler is a teacher of drama and speech at Carmel High School in California's Carmel-by-the-Sea. . .Ruth Potts, graduate of the University of Illinois and one-time teacher of the English and French languages, is a housewife and free-lance article writer who, with her teacher-husband and two young daughters, lives at Niles, Michigan. Among her hobbies and enthusiasms Mrs. Potts numbers Nature study, travel, gardening, antiques and music. . . Bill Geagan, active conservation worker and prolific writer of articles and books on Nature and outdoor life, is a resident of Bangor, Maine. . .Dr. Edith S. Clements, ecologist of Santa Barbara, California, is the distaff member of the noted husband-and-wife "Clements team" of experimenters in the environmental evolution of plants, whose work at the Alpine Laboratory in Colorado and the Coastal Laboratory in Santa Barbara, California, was published in a recent number of Nature Magazine. Dr. Clements is a graduate of the University of Nebraska.

For additional book reviews, see page 493.

Zulu Journal

Field Notes of a Naturalist in South Africa

BY RAYMOND B. COWLES

The author knew the Hluhluwe valley in Natal first as the adventurous child of American missionary parents; a lifetime later he returned as a professional zoologist. This book is his report on South Africa as he knew it in boyhood and as it has changed since: from a land full of strange forms of life living in ecological balance to a land denuded, eroded, overpopulated—a land of tension and potential violence.

Scorning the sensationalism of big-game hunts, Cowles opens up instead the colorful world of Africa's little-known animals—the odd aardvark, the grotesque breviceps, the lithe cane rat, the honeymooning termite. His mind ranges over the origins of the zebra's stripes, the possible survival value of human black skins as protective coloration, the curious habits of tick birds, the suitability of fruit bats as pets. To all these subjects he brings a knack for direct, candid description, a sweeping imagination, and a winning personal warmth. Illustrated with many photographs and drawings. 282 pages, $6.00.

Wildlife of Mexico

The Game Birds and Mammals

BY A. STARKER LEOPOLD

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University of California Press
Berkeley 4, California

Contents Noted BY THE EDITOR

THE U. S. SENATE'S "MR. BILLBOARD," Senator Kerr of Oklahoma, took advantage of the Labor Day weekend rush in the Senate to put over a piece of legislative chicanery. This was in the form of an added probillboard section in the highway bill. Without any hearing, and over the strong objections of Senators Neuberger, Cooper, Martin, Prouty and Scott, the provision was briefly considered by the Senate Public Works Committee and voted into the bill, 8 to 6.

The objectionable section exempts from the agreements controlling outdoor advertising those segments of the Interstate Highway System "which traverse commercial or industrial zones within the presently existing boundaries of incorporated municipalities. . . or other areas where the land use as of the date of approval of this Act is clearly established by State law as industrial or commercial."

This provision is slightly watered down from a section that had been first gotten into the House bill and then removed by substitution of "clean" bills sponsored by Congressmen Buckley, Fallon and Scherer. The highway bill was passed by the House and went to the Senate committee. It was at this point that Senator Kerr stepped in.

On the Senate floor Senator Neuberger led the fight against the offensive section, moving to strike it out. In debate he was aided by Senators Clark, Cooper, Kuchel, Allott, Cotton and Carroll. Senator Kerr opposed elimination of the section, contending that it "clarified" the law as enacted by the second session of the 85th Congress. The vote was 44 to 39 against the motion to strike out. Curiously, both Senators from Hawaii, where billboards are anathema to the populace, voted to support the Kerr provision. It was also surprising to find Senators of such caliber as Anderson, Hayden, Mansfield, Mundt, Muskie and Saltonstall voting to retain this crippling provision.

Far from "clarifying" the law, it complicates its application, which was, of course, the intent of its sponsors. The provision was opposed by the Secretary of Commerce and by all the groups that supported the moderate regulatory law passed last year. The section is a plain invasion of States' rights, and, most important, it hinders control in the interests of safety. Esthetics are involved to a minor degree. Both the Automotive Safety Foundation and the American Automobile Association have emphasized the importance of eliminating signs of all sorts that would compete for attention with official signs on stretches of the Interstate System approaching interchanges. Since these points of egress and ingress are most numerous in urban areas, advertising control to assure safer travel on high-speed highways is vital.

No State has sought any such exception as Senator Kerr espoused. Indeed, Governor DiSalle of Ohio recently vetoed such an amendment to Ohio's excellent law, doing so in the interest of safe travel. It is no exaggeration to say that Senator Kerr and his supporters have contributed to increase in the already tragic toll of highway accidents by this ill-considered or misunderstood action.

THE WILDERNESS BILL WAS SHELVED by the first session of the Eighty-Sixth Congress, with the promise that it will be given very early consideration when the second session meets next year. This bill has been given about as extended and extensive hearings as any piece of proposed legislation—certainly far more than any other piece of conservation legislation. It has been amended in many ways to the point that it would seem to justify no reasonable opposition. It is supported by an imposing bi-partisan list of both Senators and Congressmen. One reason for postponement was the illness of Senator O'Mahoney, who is extremely interested in the bill. It is to be hoped that the promise of early consideration will be kept, and that this important conservation measure will enjoy early approval.

CREATION OF A YOUTH CONSERVATION CORPS, as provided by Senate Bill 812, was approved by the Senate by a vote of 47 to 45, but further consideration lapsed with adjournment of the first session of the present Congress. Hearings have not yet been held by the House Labor Committee, to which the measure has gone. Although not considered as a proposal related to the problems of juvenile delinquency, the bill has acquired some relation to this widespread problem, particularly in New York State, where some such solution has been seriously put forward. The measure has not been received with enthusiasm by the various agencies of the Government concerned with conservation. Nevertheless it deserves continued consideration by the second session of the Eighty-Sixth Congress and serious study as to the possibility of coordinating the idea with our national conservation program. R.W.W.

PHOTOGRAPH BY TED AND TONY MORELLO

The termite-riddled lintel of Temple I doorway, made of sapodilla wood, still supports a ponderous masonry load after a thousand years. The doorway frames partly cleared Temple II at the opposite end of Tikal's Great Plaza.

Tikal Wildlife in Flesh and Stone

By TED MORELLO

The popular name of Temple I, "Pyramid of the Giant Jaguar," stems from sculptured wood lintel of an interior doorway.

GUATEMALAN TOURIST BUREAU

ON A January day in 1956, a Guatemala Air Force plane shivered to a stop on an airstrip that was no more than a scar in Guatemala's northern jungle.

A curiously mixed group of scientists stepped from the plane into the hot sun. There was archeologist Edwin M. Shook, on leave from the Carnegie Institution of Washington to act as field director of the University of Pennsylvania's "Tikal Project." Close behind came three University of Michigan natural scientists—Dr. Theodore H. Hubbell, the Museum of Zoology's director and curator of insects; Dr. Irving J. Cantrall, curator of the museum's Edwin S. George Reserve and Insect Division; and Dr. Laurence C. Stuart, a herpetologist and professor of zoology.

The delegation casually symbolized one of the hemisphere's newest and most ambitious archeological under-

takings. For, in a ten-year program aimed at solving the mystery of the Maya Indians, the Pennsylvania team has invited naturalists to Tikal, forest-ringed ceremonial capital of the vanished Middle American civilization. Natural scientists are responding enthusiastically.

The setting for biological studies is unique. It encompasses not only surrounding virgin jungle but the city ruins themselves.

Botanists pursue their studies up stepped pyramids or man-made plateaus to palaces and temples whose very walls and rooftops sprout a strangling growth of both low vegetation and giant trees. Other naturalists stalk birds and mammals along narrow trails that overlie paved causeways whose original great width is outlined by flanking parapets. The *aguadas*—stone-lined reservoirs built more than a thousand years ago—support a rich and varied aquatic and amphibious life.

Even the Great Plaza, Tikal's ceremonial nucleus, was a biologist's paradise. During selective tree-felling in the plaza, the Michigan group had the rare opportunity of collecting high-dwelling arboreal specimens.

Tikal's beginning dates back to perhaps 1500 B. C. It rose to pre-eminence during the Classic Period (300-900 A.D.) of this most advanced of the hemisphere's aboriginal cultures. Then, at the beginning of the tenth century, the builders of Tikal, Uaxactún—12 miles to the north—and other Classic cities abandoned these magnificent centers almost simultaneously. Why? That riddle lies at the roots of the Tikal Project, and challenges those taking part in it.

Tikal was first seen by a European in 1696. Promptly forgotten, it was rediscovered in 1846 by a Guatemalan colonel. Subsequent decades brought such scholars as A. P. Maudslay, Teobert Maler and Sylvanus G. Morley.

The scientific contributions of these and other Tikal pioneers were invaluable. Yet there were serious limiting factors. Access to the site was possible only by mule through almost unyielding forest. Living accommodations were nonexistent; early scientists slung hammocks under corbeled vaults of unventilated temple rooms more suitable to priestly ritual than to cozy living.

During the June-to-November wet season, nearly seventy inches of rainfall discouraged all but the hardy *chicleros*, woodsmen who bleed the sapodilla tree of the latex from which chewing gum is made. In the rainless months the arid land was almost devoid of the potable water essential to sustained field research.

UNIVERSITY OF PENNSYLVANIA MUSEUM

Tikal Project archeologists and cooperating biologists were ferried to the isolated jungle ruins aboard a transport of the Guatemalan Air Force.

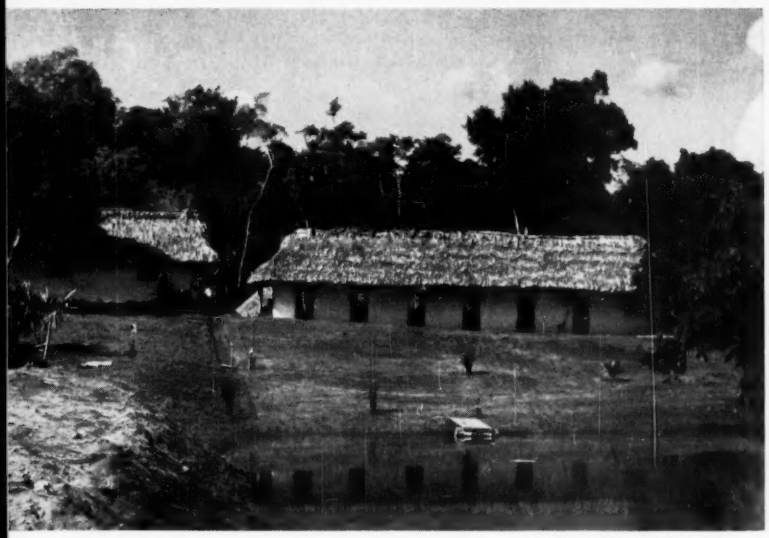


PHOTO BY TED AND TONY MORELLO

Open-sided, thatched *champas* that first housed early Tikal Project scientists have given way to walled, comfortable living quarters and laboratories. The stagnant *aguada*, or water hole, in right foreground is a haven for turtles, frogs, aquatic birds, and a six-foot crocodile.

Under such conditions it was not surprising that, as Dr. Stuart put it: "The work on a mere catalogue of the region's animals has not even been touched."

Yet, because of the Tikal Project renaissance, Stuart was able to collect within a few months 775 specimens of snakes, turtles, lizards, toads and frogs representing fifty-two genera and sixty-six species and subspecies—virtually all within a square kilometer centered at the Great Plaza.

Dr. Hubbell and Dr. Cantrall brought back 25,000 specimens of Orthoptera—katydids, crickets, grasshoppers, roaches and related insects—and an array of millipeds, centipedes and beetles. Paul F. Basch, who joined his Michigan colleagues later, collected fifty species of land snails and six aquatic types.

Frank B. Smithe, a New York amateur ornithologist, identified some 200 bird species in a few months. Working in cooperation with Dr. Raymond A. Paynter Jr.,

assistant curator of birds at Harvard's Museum of Comparative Zoology, he also collected bird skins and skeletons for the Cambridge museum.

The Tikal Project is primarily an archeological program to investigate and restore principal structures. But as Mr. Shook points out: "If we are to interpret successfully the growth and decline of Maya civilization, we shall need more than archeological evidence. Any study that can amplify our knowledge of the physical environment—climate, geology, flora and fauna—will be most welcome. We have repeatedly stressed our interest in cooperating in such studies."

What archeologist Shook calls "the multiple discipline attack" already has brought results. Such coordinated studies "have scotched a number of early theories and laid a solid foundation for our knowledge of the environment in which the Maya culture developed."

"One example may be cited," Mr. Shook continues. "The modern study of the botany of this area conclusively, I believe, demonstrates that there has been no drastic climatic change since the Maya abandonment. This is shown by the dominance in the local forest of *chico zapote* (sapodilla), logwood and other plants at the present time. These were greatly utilized by the Maya for vault beams and doorway lintels more than 1000 years ago."

To biologists and lay Nature enthusiasts too, an important consideration is that Tikal has become readily accessible. Its landing strip is a scant hour by airliner from Guatemala City, itself only five flying hours from Miami.

Additionally, the new Tikal offers greatly improved living and study facilities. The Michigan team and others who visited the ruins in 1956 slept in mosquito-netted hammocks under an open-sided, thatch shelter called a *champa*. Once, a night-marching column of army ants invaded the Michigan *champa* and was repelled only by lye hastily concocted from ashes and water.

Today the camp, atop a grassy knoll, consists of comfortable bungalows with solid walls, beds, screened windows and doors and concrete floors. Gasoline generators supply electricity for lights. Gas refrigerators provide ice for scientific uses, or more convivial purposes.

The monkey population in the vicinity of Tikal, once heavy, was decimated by an epidemic of yellow fever in 1957. These two young spider monkeys, *Ateles geoffroyi*, seem to attest to a resurgence of these mammals.

UNIVERSITY OF PENNSYLVANIA MUSEUM

UNIVERSITY OF MICHIGAN NEWS SERVICE

Staff and visitors take meals at the nearby dining hall that adjoins a twenty-four-guest lodge. The inn was built by the Tikal Project and sold for private operation to Antonio Ortiz, the project's chief foreman.

The drinking water problem nearly defeated the Shook team, which could work only in the dry season. Initially, potable water was flown in. Later Mr. Shook experimented with a still with unsatisfactory results. Then a mechanical well-digger drilled 600 feet with no better luck.

Finally, staff archeologist Aubrey Trik resorted to the "Bermuda system." Two 5000-gallon tanks were built of native cedar. Placed under the eaves of a specially designed roof, they catch

In the photograph at the left, University of Michigan conchologist Paul Basch scales a Maya pyramid with the aid of some convenient masonry-wrecking tree roots.

TED AND TONY MORELLO

The limestone quarries of Tikal yielded monoliths that the Mayas sculptured into time-marking stelae, or "writing stones." Many of the hieroglyphs are stylized animal figures.

TED AND TONY MORELLO

The trunk of the sapodilla tree at the right bears latex-bleeding scars made by chicle gatherers before exploitation was banned by Tikal National Park decree.

enough water during the rains to last through the drought.

The Guatemalan government has designated 576 square kilometers—222 square miles—radiating from the Great Plaza as national park. Hunting and commercial exploitation are banned. Besides preserving the ruins, the law protects the sapodilla, mahogany and native cedar, the most severely exploited trees in the jungle-covered department (State) of El Petén. Oil companies, whose exploration rights cover El Petén, are barred from the park.

The Tikal region lies at the base of the Yucatan Peninsula. It occupies a rolling upland of limestone, from which the Mayas quarried magnificently sculptured stelae, building stone and lime for construction. The Tikal Project has reopened the quarries to get materials for rebuilding the root-torn masonry structures.

At 900 feet, Tikal's elevation is close to the region's maximum. The mean annual temperature of 80 degrees ranges from a mean maximum of 86 in April or May to a mean minimum of 74 in December or January.

Vegetation is divided roughly into the "high forest" of the uplands and the "low forest" of the extensive, silted-in lake beds, called *akalchés*. The high forest is dominated by trees up to 150 feet tall. Little light penetrates to the ground, and undergrowth is relatively sparse. The low forest, seldom more than sixty feet high, is a tangle of trees, shrubs and lianas that makes passage impossible without diligent machete work, even in the dry season. When rain floods the *akalchés*, they are impassable.

The transitional nature of this region between the dry scrub forest of outer Yucatan and the true rain forest to the south is mirrored in an overlapping of both plant and animal life.

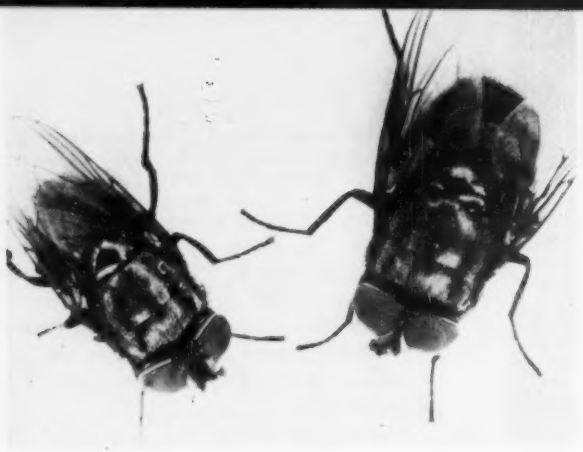
"A novice in the tropics might find the region's biology confusing," Dr. Stuart observes. But he adds that, because of Tikal's research facilities, "it would be a wonderful center for the study of many ecological problems." This is a view that is shared by many.

Varied biological investigations already have begun or are planned at Tikal. Dr. Hubbell and Dr. Cantrall hope to supplement their dry-period entomological work with a rainy-season study. Dr. C. L. Lundell, director of the Texas Research Foundation at Renner, Texas, has begun a three-year botanical survey supported by the Rockefeller Foundation. A pioneer in Maya area botany whose investigations span three decades, Dr. Lundell seeks to reconstruct the background of the Maya culture with particular reference to agriculture.

Dr. Paul B. Sears, chairman of Yale's Conservation Program, hopes to collect cores from *akalché* sediment for pollen analysis. He used the stratigraphic technique, called palynology, in the Valley of Mexico to trace vegetation changes since the time of pre-Aztec cultures that were contemporaneous with the Classic Mayas. No such research has ever been done in the Maya area.

Jorge A. Ibarra, founder and director of Guatemala City's Museum of Natural History, has cooperated with Dr. Paynter and Mr. Smithe in ornithological studies. As a pioneer Central American conservationist, he also has conducted studies of the jaguar aimed at introducing legislation against indiscriminate hunting of this largest American cat. Tikal field studies already have convinced him the jaguar is economically important because rodents appear to form a larger part of its diet than had heretofore been realized.

The international character of Tikal research is illustrated by field work conducted on bats and monkeys by the Pan American Sanitary Bureau; on insects by an entomologist from the United Nations Educational, Scientific and Cultural Organization (UNESCO); on butterflies by an expert from England; and on shells by a specialist from Belgium. *(Continued on page 499)*



The screwworm fly, scourge of livestock men of the Southeast, is bluish-green in color and about three times the size of the common house fly. The average life cycle of this insect is about twenty-one days.

With the help of radioactive cobalt,

Science Attacks the Screwworm

TODAY, more than ever before in its infant history, atomic energy is being utilized to advance the frontiers of science in the interests of peace and productivity. This is particularly true in the world of agriculture.

Currently under way in this field is a revolutionary program—the use of nuclear power as a means of eradicating the screwworm, one of the worst menaces to livestock growers in the southern United States.

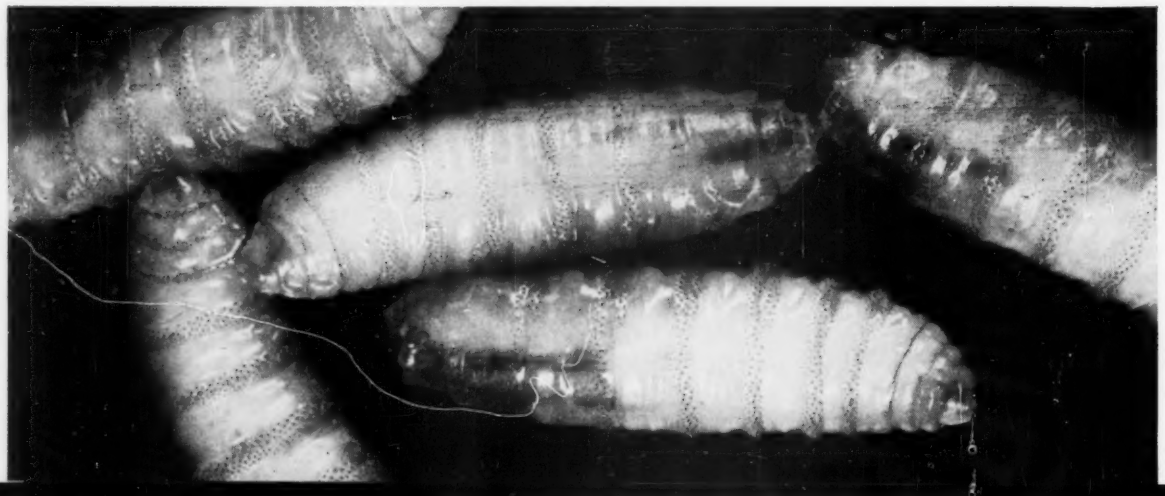
The deadly work of this pest represents a yearly loss of 20 million dollars to livestock raisers, particularly hard hit in the Southeast. To the cattleman especially, the fly is no longer simply an unpleasant menace—it has become a dangerous, uncompromising foe that threatens the industry.

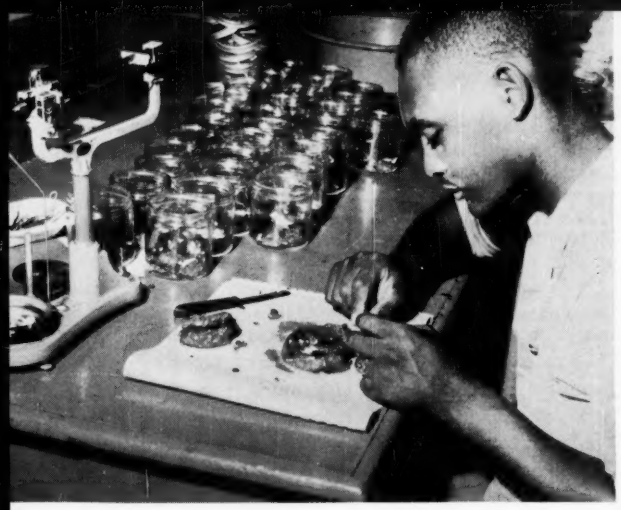
This insect, technically known as *Callitroga hominovorax*, and identified as early as 1842 in Texas, has been a serious killer of herds since 1933. Severe screwworm outbreaks have been reported frequently in Florida, Georgia, Alabama, South Carolina, Mississippi and Tennessee. Surveys also have determined that from time to time infections were present in Kentucky and Virginia and as far north as New Jersey.

The screwworm's looks belie its destructive instincts. In appearance it resembles the common "blow fly," is bluish-green in color and has three dark stripes on its back.

Although mating only once, the female is capable of laying from 100 to 400 eggs at a time on the edges of wounds in warm-blooded mammals. Depositing eggs at four-day intervals, she is able to lay as many as 3000 whitish eggs. Within six to twelve hours the eggs hatch; the mature larvae leave the wound or lesion in about five days, and burrow in the soil. In approximately two

The larvae of the screwworm fly are shown below, greatly enlarged. One of the steps in the United States Department of Agriculture's program against the screwworm is the cultivation of such larvae, as shown in the photograph directly opposite this picture on the next page.





Egg masses are collected each day and weighed to determine the number. (Twenty thousand screwworm eggs weigh one gram.) The eggs are transferred to moist paper and kept overnight while they hatch. At the left, U.S.D.A. worker Kenneth Hamm is photographed as he weighs eggs.

The female screwworm fly lays an average of 200 eggs to the cluster on the edges of cuts or wounds or on the navels of new born warm-blooded mammals. The eggs hatch into larvae that feed on the living flesh, injuring and eventually killing untreated hosts.

By NORRIS RANDOLPH

Photographs courtesy U. S. Department of Agriculture

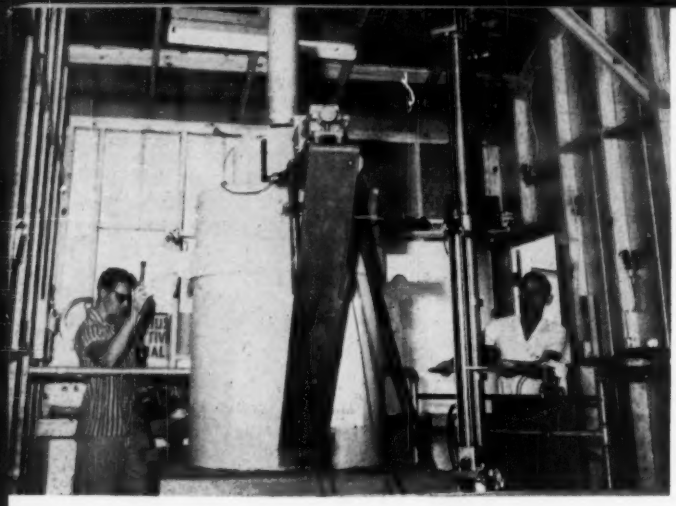
weeks, the outer skin of the larva having hardened and formed a pupal case, the adult fly emerges. In two to five days the fly is ready to mate and continue the cycle. The average egg-to-egg cycle is twenty-one days, although cool weather may prolong it.

Predatory beetles and ants destroy some of the larvae and pupae, but not in sufficient numbers to effect any appreciable control. Nature's most efficient population regulator is temperature. If the daily average temperature is less than 55 degrees Fahrenheit for more than two months, screwworm pupae die in the soil. In winter, therefore, the "survival line" is considerably restricted, and the pest can usually over-winter only in Florida, south Texas and Mexico.

During the spring and summer, the screwworm fly is on the wing and at its most active. It can migrate thirty-five miles weekly, infesting all of Florida, the southern two-thirds of Georgia and the southeast corner of Alabama in the Southeast; most of Louisiana, Arkansas, Texas, southern New Mexico, southern Arizona and California in the Southwest; and Oklahoma, Kansas and Missouri in the mid-West. However, the days of the screwworm seem to be numbered—at least in the Southeast.

In 1951, new techniques were undertaken to eradicate the insect in preliminary experiments. Using X-ray equipment, scientists and entomologists revealed that female screwworms, when sterilized by radiation, were infertile. Similarly, normal female flies, after mating with males made sterile by radiation, produced eggs

Screwworm larvae are reared in shallow vats, in a medium of finely ground lean meat, citrated blood, water, and a small amount of formaldehyde. Here Frank Dudley of the U. S. Department of Agriculture checks temperature of the mixture to be sure it remains at the required 100 degrees F.



The large lead cask in the center of the room shown at the left contains radioactive cobalt (cobalt 60). A canister of screwworm pupae is being manipulated in and out of the irradiation chamber by means of a pneumatic hoist and grapple. Operating the controls is W. D. New, while Carlton Burroughs monitors for radioactivity.

that did not hatch. Could this be a means of control?

After achieving notable success in mass-rearing sterile flies under laboratory conditions, a small-scale field test was begun on Sanibel Island, off the west coast of Florida.

The results of this exploratory study were not conclusive, since screwworm flies from the nearby mainland infiltrated the island and reinfested it. Yet researchers nevertheless gained first-hand experience in propagating, mass irradiation and liberation of treated screwworms. An important step forward had been taken. The battle lines were being drawn.

Backed by further experimentation in rearing techniques, sterilization by exposure to cobalt 60, and the behavior habits of the fly in the laboratory, the United States Department of Agriculture entomologists were ready for the first major offensive.

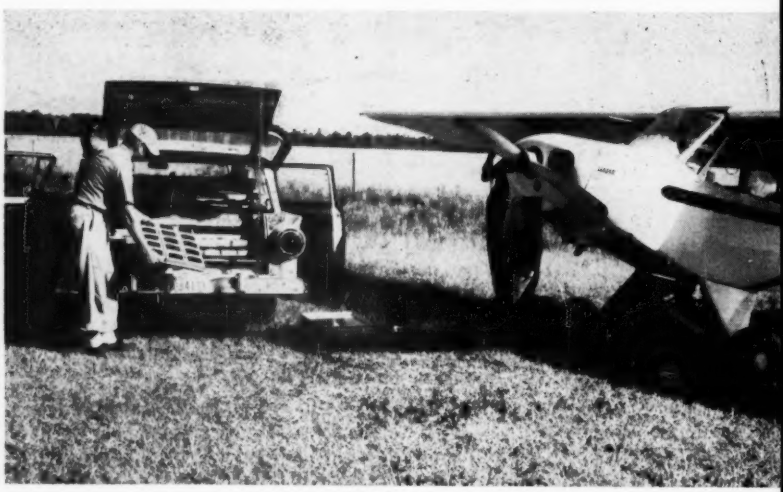
On March 26, 1954, seventeen thousand sterile male screwworm flies, the first batch to be exposed to the gamma rays of radioactive cobalt, were released by airplane over Curacao Island, in the Netherlands West Indies. Systematic releases of flies were continued weekly.

Five months later, a ground survey showed that the screwworm population was decreasing, but not disappearing. The number of sterile flies was increased from 100 to 400 per week on each of the island's 170 square miles. Eradication occured rapidly. Since December, 1954, Curacao, fifty miles from the nearest land and therefore safe from migratory flies, has been safe from the screwworm. Reviewing its findings, United States Department of Agriculture officials determined that the vexing problem in the Southeastern States could probably be handled as it had been during the Curacao test.

In Texas and the Southwest, however, the diagnosis was not as encouraging. The area's geographical location posed a knottier question, since normal flies can immigrate from Mexico with impunity.

Deciding on an all-out campaign in Florida, the Department was aware that many scientific problems had to be solved before such an important launching could be undertaken. It was necessary to know how to blanket

A measureful of irradiated pupae—about 550—is placed by technician W. D. New in partitioned and ventilated cardboard boxes, ready for distribution.



In the photograph at right, Leslie Britt prepares to load boxes containing sterile screwworm flies on a waiting plane. Before leaving the laboratory, the flies are given a meal of honey by spreading the liquid in thin "strings" over the screen top. An air-conditioned station wagon is used to transfer the trays of fly boxes to the airport.

an area of 50,000 square miles rather than Curacao's 170. The weekly rearing and distribution of 50,000,000 sterile male and female flies presented its own problem. Many additional scientists had to be gathered. The Florida eradication scheme had to have more than the half-dozen men who had worked on the Caribbean project.

The job of raising and sterilizing a million flies a week was begun on a pilot plant basis. In the spring of 1957, fortified by more experimentation and study, entomologists decided to put their experience and knowledge to use in the major operation.

Between April and August, in a zone forty by fifty miles southeast of Orlando, 2,000,000 sterile male screwworm flies were released from low-flying airplanes at a rate of 500 per square mile, each week for four months.

At first it was doubtful that the egg count would be reduced because of the infiltration of normal screwworms, as well as emigration of sterile flies, in the 2000 square mile area. But even with reinfestation from three sides, seventy percent sterility was obtained in twelve weeks. Valuable data also was compiled on the percentage reduction of fertile eggs at the center, as opposed to that beyond the area's boundaries.

At last, after years of testing, research and planning, a screwworm eradication program for the Southeastern States switched into "high gear." Last summer, with the completion of fly-rearing facilities on a gigantic scale at Sebring, Florida, extermination tactics were begun.

From first to last, the process requires intricate, exacting performance. When the screwworm pupae are five and a half days old, they are packed in canisters in lots of 18,000 and lowered into a cask of cobalt 60. They are exposed to this radioactive substance for about twelve minutes, or long enough to become saturated with 8000 roentgens of gamma rays. On removal, the screwworm pupae are placed in cartons resembling small egg boxes, and stored in an air-conditioned room at a constant temperature of 80 degrees F. until the flies emerge.

Then they are ready for distribution by twenty light planes that fly six hours a day, six days a week, from such central locations as Orlando, Gainesville, Miami, Sebring and Tallahassee, Florida, and Troy, Alabama. Besides the pilot, each plane carries a U. S. D. A. crewman who handles the systematic dispersal of 1000 boxes of flies a day.

Various kinds of release mechanisms had been tried before a Department scientist designed the most satisfactory one to date. It is an automatic dispersing apparatus that may be timed for various dispersal rates, and which opens and counts the cartons as they are dropped. This method is a far cry from the one used at Curacao, where dispersal was a matter of tearing open fly-filled paper bags and throwing them out of the plane!

Every safety precaution is taken to safeguard all workers and scientists from overdoses of radioactivity. Technicians who work with the cobalt 60 casks are equipped with film badges and pocket chambers. In the event a cask malfunctions, it can be hoisted through the roof of the building and immersed in water before repairs begin. Workers receive special attention so that they may not inadvertently carry any fertile female flies from the plant. Showers and a fresh change of clothes are mandatory at the end of each shift.

By the middle of the past summer, approximately two and one-half billion flies had been reared for the 50,000 square-mile region encompassing the Florida Peninsula and the southeast corner of Georgia. As an added precaution during the two to three years it may take to eradicate the pest there, the average overwintering line has been extended 100 miles to the north. Livestock inspectors, manning more than 100 fly traps, gather information weekly on the incidence and relative abundance of both wild and sterile flies throughout the treated area.

Although the project is far from completed, "Operation Screwworm" furnishes a fine example of how the power of the atom can be used to benefit man rather than to destroy him.

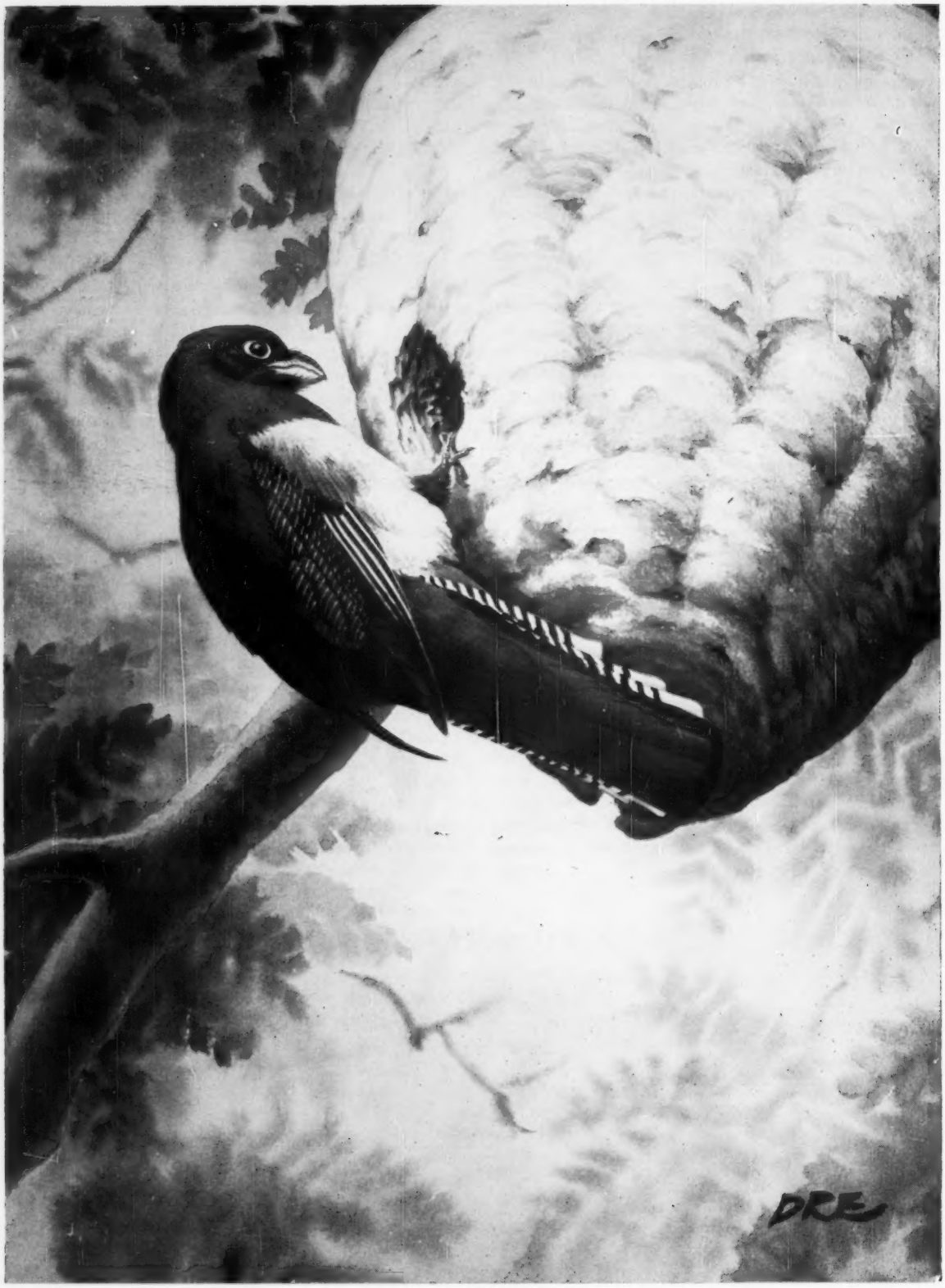
SUN AFTER FROST

The gilt-edge stock of summer has been spent
—petals scattered, and leaf and sunlight tossed
like coins to wind by the improvident
impulse of a night of freeze and frost.

And now comes day, creeping thinly by,
like a beggar who has spilled his cup,
fumbling at gardens, meadows, trees and sky
to see what it may find to gather up.

And from squandered summer, damage done,
retrieves some penny trifles; stoutly clings
to the last treasure of a slanting sun,
a few thin flowers, and some lonely wings.

Helen Harrington



Using her tail as a brace, the female violaceous trogon above is converting an occupied wasps' nest into a birds' nest.

Trogons and Wasps' Nests

By ALEXANDER F. SKUTCH

Illustrations by Don R. Eckelberry

On a steep slope above the Río Buena Vista, in southern Costa Rica, was a recent clearing in which a number of tall, charred trees stood gaunt and desolate above the low, tangled growth that had sprung up after the harvest of the maize, for which the clearing had been made. To the south and east of the opening the heavy rain-forest stood up like a wall more than a hundred feet high. To the north rose the long, tree-clad ridge of the continental divide, part of the Cordillera de Talamanca; while on the west, far below, one caught glimpses of the river flowing impetuously along its rocky, tree-shaded channel through the cultivated and resting lands of the valley.

On many a morning in the dry month of February I climbed up to this old cornfield from my thatched cabin in the valley, arriving while the light was still dim to watch the exit of the woodpeckers, toucans, and other birds that roosted and nested in cavities in the fire-killed trees. One day, at the end of the month, before the sun had risen above the crest of the ridge, I heard full, mellow notes, *cow cow cow cow*, floating out of the adjoining forest. It was a typical trogon's call; and from the even flow of the notes—many in a series, all on the same key, with scarcely any acceleration or rise in pitch toward the end—I recognized its author, the violaceous trogon, *Trogon violaceus*.

Presently a pair of these birds flew out of the forest, passed in strongly undulatory flight across a corner of the clearing, and came to rest in the spreading crown of a magnificent guanacaste tree at its edge. Here, high above the ground, they perched with their usual upright posture, their long tails hanging straight down. The male was a splendid bird, with metallic golden-green upper plumage. His head was black, his chest violet-blue, his lower breast and abdomen orange-yellow. The under side of his tail was evenly barred with black and white. His short, thick bill was pale bluish-gray, while each dark eye was surrounded by a ring of naked, orange-yellow skin, conspicuous from afar. His mate was far less brilliantly attired, with dark slaty plumage on her head, neck, back and breast, yellow on her abdomen.

After resting for a while on their high, exposed perches, these graceful birds began to fly against a large wasps' nest, suspended from the end of one of the lower branches of the great guanacaste tree, about a hundred feet above the ground. About a foot in length, this nest, covered with silver-gray carton, was shaped like a boy's spinning-top. The doorway was in the spout-like lower end.

Two weeks earlier I had watched a pair of these trogons, I believe the same that I now had before me, digging into a somewhat dilapidated and seemingly old nest of the same sort, apparently to hollow out a cavity for their eggs and young. This was a surprising discovery; for although I already knew that some trogons excavate their brood chambers in the hard, black substance of a termitary, I was not aware that any bird used a wasps' nest for rearing its family. But now these violaceous trogons were turning their attention not to an abandoned nest but to one occupied by a swarm of stinging insects. I had thought of trogons as the perfect gentlemen among the tropical American birds, all of whose ways were in keeping with the quiet dignity of their upright posture and their soothing, mellow notes. I had never seen trogons of any species attack a bird of another kind, and their disputes among themselves were always settled by much calling, with now and then a harmless dart toward the adversary; never a grappling encounter. Were these trogons, so gentle and mild, capable of capturing an occupied wasps' nest?

The spout-like lower extremity of the nest had been partly broken away, possibly by the trogons on an earlier visit, but a transverse partition closed off the bottom. Low in the side that faced out from the supporting tree a narrow opening had been made, and the birds were trying to enlarge it. Of a sudden one of them would leave its lofty perch, dart to the nest and, poised on beating wings, take a bite at the gray carton at the hole's edge, then fly back to some convenient twig. Sometimes they would bite twice or thrice at the wall while continuing to hover. But at best their attack upon the nest was a momentary performance, evidently because they could not longer sustain themselves on the wing. Their spectacular mode of working—wings rapidly beating, yellow belly conspicuous from below—reminded me of the way they plucked a berry from a tree, or tore away a piece of the green fruiting spike of a cecropia, while poised on wing before it.

Between darts to the nest, the trogons rested quietly in the crown of the guanacaste tree, now, at the end of the dry season, clad in fresh new foliage. Male and female flew alternately at the nest, as earlier they had taken turns at digging into the abandoned structure; for with trogons of many kinds the sexes share the labor of carving out the nest cavity, and the male often takes the initia-

tive. Sometimes I heard a sharp tap as a bird's bill struck the carton wall of the nest, which must have been fairly hard; for after more than half an hour's work, during which the trogons darted against it dozens of times, the round gap, about an inch in diameter, was not noticeably larger than when they started. At the end of this period both birds flew back into the forest, and I waited until the middle of the morning without seeing them again.

Each morning the trogons came out of the woods and began to work between half-past six and a quarter to seven o'clock, while the westward-facing slope was still in shadow. By March 1, three days after I first found them, the female discovered that she could hold on to the lower edge of the slowly widening gap while she bit at its upper edge. Clinging back downward, her tail pressed against the flat bottom of the nest and spread just enough to reveal the conspicuous black and white barring of the outer feathers, she bit and tugged at the tough envelope. She worked with a will, shaking her whole body with her vigorous exertions; while now and then a crackling sound, reaching me far below, proclaimed that she had succeeded in breaking away another fragment. Her spells at the apparently exhausting labor lasted for several minutes.

A piratic flycatcher watches the trogons at work on a wasps' nest, hoping to preempt the cavity later as its own.

The male did not at once adopt the new procedure, but continued to dart at the nest and take ineffectual nibbles at it. After a while, however, he followed his partner's example. At first the female worked the harder, sometimes returning several times to attack the nest while the male rested nearby and looked on. But after an interval she seemed to tire, and now he did the greater share. Finally their parts in the task became about equal. While awaiting their turns on neighboring branches, they voiced their soft, mellow call in an undertone, as though to encourage each other. The greater effectiveness of their new method of attack seemed to stimulate them to put forth greater effort. Not only did they work more intensely than on previous mornings, but they continued longer and nibbled at the wasps' nest for a full hour before they returned to the forest.

While the trogons worked in the cool early morning, the wasps remained mostly within their nest, and I rarely saw one. As far as I could tell, they did not attack the birds nor interfere with their operations in any way. But by the middle of the forenoon, when the sun had warmed the air, the black insects became more active and swarmed about the edges of the gap which the trogons had made, while there was a constant stream of those leaving or returning to the nest.

Now the birds emerged again from the forest and began to attack the wasps. They did not perch as close as while they had been breaking into the nest earlier in the day, but at a considerable distance, and they made long, spectacular flights to snatch a wasp from the crowd about the orifice, or a lone one that crawled over the exterior. A sharp tap rang out each time a bill struck the nest in picking off a wasp. Or sometimes the birds would catch an insect in the air.

After each such dart the birds returned to perch, and then I could never detect anything in their bills, although on several occasions I clearly saw through my binoculars that they captured a wasp. Apparently they swallowed the victim while they flew, doubtless first disabling it with the pressure of their strong bills. The female often held her mouth open, as though to cool it after swallowing something hot; but perhaps she was merely panting from the exertion of her long, upward darts. For half an hour the pair continued this meteoric mode of catching wasps, the while uttering their low, pleasant *cow's*. Then they went back into the forest, but soon returned for another session of wasp-catching. Now they did not try to enlarge their opening, probably because the wasps, more active in the warmer air, would have made it too uncomfortable for them.

Although most of the wasp-catching was done later in the day, while the cool early morning was reserved for enlarging the chamber, one morning the insects appeared to be unusually active, and the trogons began to catch them before seven o'clock. The wasps seemed rarely to attack the trogons, but once I distinctly saw one of them pursue a bird as it left the nest. On another occasion I watched the male pluck from his abdomen a fluffy feather to which a wasp was clinging. The insect flew off, while the feather remained sticking to the bird's bill. Neither by scratching with a foot nor rubbing his bill against a branch did he succeed in removing it. Finally he solved the difficulty by swallow-

ing the pertinacious feather, surely a practical solution.

The trogon who in the early morning arrived first in the guanacaste tree, usually the male, continued to call until its mate arrived, and only then proceeded to work at the nest. Sometimes, even after coming to the tree, one of the pair was disinclined to labor, and after sitting around idly for a while would return into the forest. Then the other might remain for many minutes in the guanacaste, calling its recalcitrant partner; but neither of the two would continue to work while the other was absent. Such behavior is typical of trogons.

Despite these delays, the hollowing-out of the nest proceeded steadily; and soon the birds were working with the head and more and more of the body hidden from view in the cavity; so that only the lower back and the long tail, pressed against the bottom of the nest, were visible to me. Now their alternating spells of work lasted from two to five minutes. Sometimes, as one drew back its head, I could detect movements of its bill that suggested that it ate something it had found inside. What this was I could not see clearly, but it was not difficult to conjecture. The trogons were now digging their nest chamber among the wasps' brood combs; and it is highly improbable that, after devouring the hard-winged insects, they would disdain the more succulent larvae and pupae in the combs.

By March 10, thirteen days after I found the birds beginning to work, the trogons' excavation extended far into the wasps' nest, from which the black wasps had not yet completely vanished. I then went on a journey over the mountains, and when I returned ten days later the trogons' chamber appeared to be finished; but they were not yet incubating. A pair of piratic flycatchers, small birds of dingy plumage, were now almost constantly to be found perching among the outer branches of the big guanacaste tree, where the male repeated interminably his breezy, impudent calls. Sometimes one of them would disappear into the wide gap that the trogons had opened in the side of the wasps' nest. When the makers and rightful owners of this chamber arrived, they were treated as intruders by the far smaller flycatchers, who darted again and again over their heads. Mostly the trogons took little notice of these feints, scarcely even lowering their heads, although sometimes they lost patience and drove with spirit at their tormentors, causing their immediate and hurried retreat. But the pestiferous little flycatchers promptly returned and continued to harass the trogons, acting as though the wasps' nest belonged to them. Even while the birds were excavating their chamber, the piratic flycatchers had passed much time in the same tree and occasionally darted at them. But at this stage the intruders, as though aware that too much interference with the trogons would retard or prevent the completion of the cavity that they intended to use, worried them little

It was probably not by their incessant annoyance—to which the trogons seemed almost indifferent—but by the more effective method of throwing out the newly laid eggs (which I have witnessed at a nest of another kind) that the piratic flycatchers finally won possession of the coveted chamber in the wasps' nest. By early April, the female remained inside for long periods and appeared to be incubating; before the end of the month, both flycatchers were carrying in food for their nestlings. I have twice known *Legatus leucophaius* to rear broods in cavities made in wasps' nests by the violaceous trogon. But usually this flycatcher breeds in closed nests that it

The splendid coloration of the male violaceous trogon makes this dweller of the tropics conspicuous from afar.

wrests from other passerine birds: the oven-shaped nests of the yellow-breasted flycatchers of the genus *Myiozetetes;* the black, pensile, retort-shaped nests of the flatbilled flycatchers of the genus *Tolmomyias;* or the bulky, globular structures with a doorway in the side, built high in trees by the white-winged becard.

I last saw the trogons in the great guanacaste tree on April 3, when in the early morning they flew out of the forest and alighted, side by side, on a dead branch near their wasps' nest. After they had rested here quietly together for a short while, the female flew away. But the male delayed for many minutes, calling softly, before he followed her back into the forest. Neither visited the chamber that they had worked so hard to prepare. The flycatchers, no doubt feeling secure in their possession of their stolen domicile, made only one careless dart toward them.

Later in that same month I followed a female violaceous trogon that passed above me with a small caterpillar in her bill. She led me to a large wasps' nest, similar to that in the guanacaste tree, which hung, about thirty feet above the ground, from a slender branch of a small tree that stood above a brake of tall wild canes. In addition to the round doorway of the trogons'

chamber, there were several other gaps in its silver-gray envelope; and it appeared old and worn.

The nestlings that it held were fed and brooded by both parents, of which the female attended them through the night. To pass food to the youngsters the birds clung in the entranceway with only rump and tail showing, and after delivering the meal they climbed in to brood. The tail feathers of both parents were crumpled and bent from long sitting in the confined space. Standing below and a little to the front of the nest and peering through binoculars into the dark cavity, I could clearly distinguish the yellow orbital ring and light-colored bill of the male; while when the female was brooding I could discern her bill, the whitish crescent behind each eye, and the whitish spot in front of it. Otherwise the dark heads of both were vague and shadowy in the dimly lighted cavity. The female must have felt quite safe in her high chamber, and neither walking heavily over the crashing fallen canes and crackling dead leaves, shaking the supporting tree, nor hammering on its trunk made her fly forth. The male sat through everything—including the throwing of my cap up toward him—except shaking the tree, which brought him out. When disturbed, both parents complained with a low rattle, which they uttered while slowly elevating their tails, and soon they returned to their nestlings. Trogons with low, accessible nests lean out to investigate if they hear a noise, and with little provocation they fly away.

Peering up into the cavity a fortnight later, I noticed three indistinct light points in the dark circle of the orifice. These proved to be the bills of the three nestlings, whose heads I could vaguely distinguish. While waiting for their meals, the youngsters uttered almost continuously a low, sweet-voiced *cow cow cow*, like the call of the parents but more subdued. As each nestling delivered this note, its throat became faintly visible as a light point amid the darkness, an effect caused by the exposure of its pale skin as the sparse plumage was spread apart by the throat's expansion. Once one of the youngsters leaned so far over the entrance shaft that I could see part of its whitish abdomen, but otherwise its plumage was too dark to be distinguished in the dimly lighted chamber. From time to time the little trogons regurgitated seeds, which fell through the opening to the ground. Twice their mother passed food to them while I stood almost directly below her. Brooding had now ceased, and after each visit the parent flew away.

Sixteen days after I discovered this nest, already with nestlings, the youngsters abandoned it. I found one stubby-tailed fledgling resting on a low twig amidst the cane brake, repeating incessantly its low *cow cow cow*. Almost fearless, it took wing only when I was a few inches away; but its flight was still so weak that I easily overtook and captured it. After a little ineffectual struggling in my hand, it submitted meekly to its fate—the careful examination of its dark plumage, which resembled that of its mother. When I set it on a perch below the nest, she arrived with food and allowed me to approach within a few feet while she rested near her fledgling.

At the end of May, three years later, I found a pair of violaceous trogons attacking a wasps' nest of the same shape as that in the guanacaste tree, but inhabited by another kind of wasp, yellowish instead of blackish. Instead of catching the insects in the middle of the morning, like the first pair, these trogons would begin in the dim light of dawn and continue for about an hour, until the sun stood low above the crests of the distant mountains. From perches of about the same height in the neighboring shade trees of the little coffee plantation where this nest was situated, the birds shot swiftly past the wasps' citadel, sometimes skimming the outer surface, sometimes merely darting past the doorway, about which the insects were swarming. Without much doubt they were eating the wasps, probably making their breakfast of them; but their movements were so swift, and the insect vanished so rapidly, that it was difficult to see just what happened.

Usually, after dashing past the wasps' nest, the trogons came to rest at a respectful distance; but occasionally they did not go far enough, and pursuing wasps would cause them to retreat. Or else the birds would try to beat off the assailants with their wings. This wasp-catching in the early morning continued for at least fourteen days before I found the trogons so engaged later in the day. In the warmer air of the early afternoon the wasps were much more active than at daybreak, sallied forth with greater zeal in pursuit of the birds, and often sent them into hasty and undignified flight. These trogons caught the wasps earlier in the day than the first pair because here, at an altitude of 2000 feet above sea level in June, nights were far warmer than they had been a thousand feet higher in February and March; and consequently the insects were more active before sunrise. After a clear, cool night in early February, even at 2000 feet, wasps of some kinds would be so torpid at daybreak that if they fell to the ground they could not rise.

After more than a fortnight of persecution, the inhabitants of the nest had been noticeably diminished in number; and now at last the trogons began to dig their chamber. The papery envelope of the nest had been frayed and broken, especially at the nether end, by the trogons' impacts against it while they caught the wasps; and the brood cells were exposed at several points. The male and female of this pair could not agree as to where to start the excavation. The female chose the customary position, on the side of the nest facing out from the tree, where (*Continued on page 500*)

THE SNOW JEWEL

Celebrate the snow tonight,
It is speaking soft and bright
To beauty's believers now. . .
It is strange how diamonds grow
In the trees, on poor men's coats. . .
Even some on sparrow throats.

Marion Schoeberlein

A floral pioneer in the water conservation movement is the plant of the saltbush family commonly known as "desert holly," inhabitant of the parched, alkaline soils of California's Mohave and Colorado Deserts.

Silver Beauty of the Desert

Against the black gravel bed of a desert wash the rounded form of a desert holly plant makes a decorative figure. This plant can exist under conditions of less than three inches of rainfall a year, and in places where ground temperature, during summer months, may rise as high as a hundred and eighty degrees.

By
HAZEL MOHLER

When we hear the word "holly," most of us think of glossy green leaves and red berries. And because the word carries the connotations of the traditional plant, it is not often realized that the popular name "holly" is given to a plant that is not holly at all. This plant is often called "desert holly," and it looks as if it has been dipped in silvery-white paint when it is seen sparkling in the brilliant sunshine. It belongs to the genus *Atriplex*, not to *Ilex*, the true holly genus.

At first glance, the resemblance of this desert plant to true holly is seen in the characteristic shape of the leaves. Even though the leaves are miniature in size, the immediate reaction is: "This surely looks like a silver variety of holly." And sometimes the plant is known by the name of silver holly Yet, to get the full impact of its glistening beauty, one must see the shrub growing in its native regions.

Nowhere is this bush found covering large areas. It can be found in the Mohave and Colorado deserts, in Death Valley, and in Owens Valley of California. Desert holly grows sparsely in southwestern Utah, southern Nevada and western Arizona, and also can be seen in Sonora, Mexico, and in parts of Lower California.

To many, this specter of glowing white is considered the most beautiful of desert plants. Unlike many of the bushes on the desert that are hard to identify—except during their brief leafing and flowering periods—holly can be recognized the year around because it retains its sharply scalloped leaves. Although the scurf on the leaf is always white, in the fall and dry winter months it displays a silver sheen, while after a rain the plant takes on a greenish tinge. And during the summer it has a silvery-pink cast, as if slightly sunburned by the intense heat of the desert sun.

There is an Indian legend, told in Death Valley, that Rabbit once became angry at Sun and chased him across the sky with an arrow. The Sun fell from the sky and landed in the mud hills near Furnace Creek, in Death Valley. The source of this legend probably stemmed from the fact that the ground in this area may register as much as 180 degrees of heat in summer. Perhaps the Indians felt Sun burned all growing things on this desert floor so that Rabbit had nothing to eat. They may have thought that the soft, white stuff that leached out of the marsh near Furnace Creek—which the prospectors called "cottonball borax"—was nothing but rabbit

fur. Or let us suppose that Sun was responsible for the rainbow of colors that shone in the rocks and from the scorched earth when the flowers burst out after a rain, with the purples of the verbenas and lupines, the gold of primroses and poppies, and the fire of Indian paintbrushes. But on this ground, the year around, grew a round, white plant. Perhaps some Indians thought of the plant as rabbit's tail. Yet it was not soft, like fur, but brittle. It had the glitter of transparent quartz,

Desert holly has suffered severely in the past from excessive commercial gathering, and California law prescribes a heavy fine for those molesting it. The plant at left has been mangled either by man or desert winds, and its rounded form destroyed.

but it was a growing thing. And perhaps there was a feeling among the Indians that this was the shining Sun rising from the valley—this bush that we call desert holly.

Like all desert plants, this one is a master at conserving water. It flourishes in the hardest rocky soils, in areas with as little as three inches of yearly rainfall. Driving south from Furnace Creek, in Death Valley, toward Badwater, the desert holly makes interesting patterns when interspersed with the darker saltbush, to which it is really related. Because of the lack of moisture, the shrubs are spaced from ten to thirty feet apart on the salt flats. The plant can grow below sea level, as one discovers when approaching Badwater (which is 279 feet below sea level), because, although it does not actually grow at the water's edge, it can be found within a stone's throw of this low point. When driving north from Furnace Creek, after passing the sand dunes, one comes to Ubehebe Crater, with an elevation of 2900 feet. Desert holly also is found there, its whiteness standing out in sharp contrast to the black volcanic ash in the crater.

Against the adverse conditions of the desert, plants like desert holly must protect themselves in order to survive. The white sheen helps reflect the bright sunshine. There is little surface for absorption. The plant has a rounded outline when fully developed, usually growing from one to three feet high, although it is not uncommon to find bushes five feet high in the desert washes. The growth is from a gnarled, woody base, and the stem is tough. Leathery leaves retain the water, and a dense scurf covers all the herbage. There are water storage cells to conserve the small amount of water available. After a rain, the leaves become quite succulent; in the long drought periods, the leaves draw together.

Desert holly blooms earlier than any other saltbush, the flowers appearing as early as February, depending on the time of the first rainfall of the year. Tiny red buds, resembling berries, burst from the stem tips. The staminate and pistillate are borne on different plants.

By late March or April the fruit appears, kidney-shaped, and light green in color. The fruit bract is flat, except for the small convex section that covers the seed.

The complete scientific name for desert holly is *Atriplex hymenelytra*. This, in Greek, means "membrane covered," with reference to the broad, membranous fruiting bracts found on the plant. The genus *Atriplex* includes plants of the saltbush and scalebush family. In it there are about 130 species, widely scattered about the earth, and common in arid, alkaline regions. In California and Arizona there are about thirty species, with many varieties being described. The desert holly was first described from the specimens collected by Arthur Schott of the Mexican Boundary Survey.

Until recently the desert holly was picked ruthlessly, both because visitors to the desert were unable to resist its beauty and because there was demand for its decorative uses. Around holiday-time, the selling of this "holly" proved profitable enough to encourage vendors to make trips into the desert to gather it by the truck load. Now an effort is made to prevent the destruction of the plant. At one time, desert holly grew in the San Joaquin Valley, but it has disappeared from that region, and it is rapidly diminishing in the other desert section. Although the practice of picking desert holly is punishable by a heavy fine, it still disappears, and only in the national monuments and parks can it be preserved and guarded with any success. In the dry season the plant is brittle and breaks easily, and many plants are lost because of carelessness or vandalism.

Not until everybody who visits the desert appreciates the constant struggle for existence these plants exhibit can a program of preservation be carried out. Desert holly thrives in the least rainfall, the greatest evaporation, and the highest mean temperature in the United States. Many Americans know now that water conservation is of vital importance, but few of us realize the significance of a *real* water shortage. We think "to conserve" means not to be extravagant.

Perhaps a plant like the desert holly, radiant in its beauty, can help us to understand the true meaning of water conservation. Since there are separate male and female plants, and since these plants, because of water shortage, are often spaced thirty or more feet apart, removing a single bush may destroy the natural balance. And although many of us would enjoy the beauty of a sprig of desert holly in our homes, we must leave this plant in its natural habitat if we expect it to survive.

Dean Emeritus Lloyd C. Emmons, at left, and John W. Hope, museologist, of Michigan State University, examine the huge shoulder blades of a Jefferson mammoth, whose bones were uncovered in a marl pit near Eaton Rapids, Michigan, by Mr. Vern Losey, some five years ago.

PHOTOGRAPHS BY CARL W. HAMMAN

Michigan Mammoth

By RUTH POTTS

FINE weather brings earth-turning time for the farmer, the bait-seeker, the gardener, and the well-driller; and once more a lucky turn of the spade may unearth a priceless relic of the past, to thrill the world and add a page to the book of ancient history.

In the State of Michigan, the latest big "find" of prehistoric bones occurred south of Eaton Rapids some five years ago, when Mr. Vern Losey, farmer and implement salesman, began to excavate a marl pit on his property. It took almost a year to unearth the "Losey" mammoth, carefully clean and preserve the bones, test them for age, and finally get them ready for display at the Michigan State University Museum.

"This chap probably lived about 12,000 years ago," said John W. Hope, museologist, "and the teeth show that he was fairly young when he died." The tooth resembles the size and shape of a man's shoe-sole, with an oddly corrugated pattern that proves the creature was a mammoth rather than a mastodon.

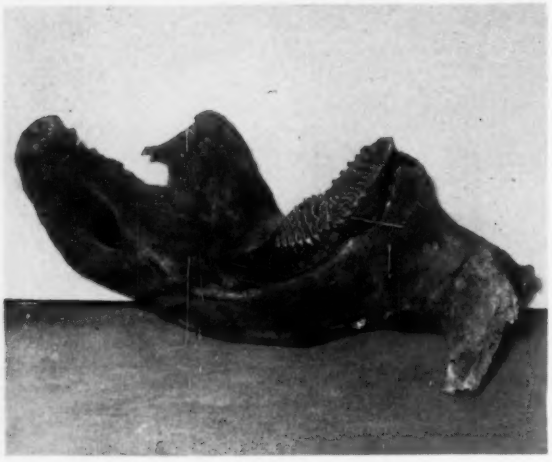
"We say 'he' because of the size of the tusks," Dean Emeritus Lloyd C. Emmons explained. "He only weighed about four and one-half tons, but the tusks are ten feet long and weighed 100 pounds each. Only a male would sport such a cumbersome ornament!"

The age of the ancient skeleton was determined at the University of Michigan by the "carbon 14" test. Fragments of hemlock wood imbedded in the shoulder blade, as well as bits of bone, were subjected to tests for radioactivity, and the Losey mammoth was judged to have wandered into the smothering swamp 12,000 years ago —plus or minus a few hundred years.

Museologist John W. Hope fits the mammoth's vertebrae and vertebral discs together like the pieces of a puzzle.

The Pleistocene epoch, or Ice Age, includes roughly the last million years of the earth's history. During this time four ice caps are known to have blanketed much of North America, and then gradually to have melted and receded. Between each of these icy periods were intervals of much warmer climatic conditions. Whether we are now in an interglacial period, or merely at the end of a glacial stage (this fourth one is called the "Wisconsin"), remains for posterity to discover and record.

The Losey mammoth now is ready to take its place in the story of early "Michigan" history. Ancestors of this giant probably crossed the Alaskan-Siberian land bridge more than 300,000 years ago. The Jefferson mammoth—as this species is called—became highly



The oddly corrugated tooth of the massive lower jawbone, about the size and shape of the sole of a man's shoe, proved that the creature was a mammoth rather than a mastodon. An aching cavity in this tooth would have been a serious discomfort!

specialized for cold-climate living, with inches of fat layered under the skin and with a wooly coat for added protection. Its extinction about 10,000 years ago occurred mainly because the mammal could not adjust to the increasingly temperate climate as the ice sheet retreated northward.

The herbivorous mammoths were apparently not as common in Michigan as the mastodons. Larger and possibly not as alert or swift, the mammoths may have been easier prey for the large carnivores; this may account, too, for the rarity of finding a complete mammoth skeleton. We can imagine a hungry cat dragging off a juicy chop or steak to munch in privacy!

Standing some nine to ten feet at the shoulder, and bulking slightly larger than the American mastodon, the mammoth grazed in the meadows near the lakes and between the forest lands. Grassy areas were probably not plentiful, and the mammoth had a harder time finding food than the browsing mastodon. Both must have had difficulty in following the receding cold climate and the new feeding grounds northward, for a belt of lakes was left by the melting glacial sheet to block their paths. This, too, probably contributed to their extinction.

The Losey mammoth is thought to be the most complete mammoth skeleton ever found in Michigan. Thirty-six of the bones are complete, eleven incomplete, forty-nine are classified as fragments, and there are twelve spinal discs; this comprises about two-thirds of the entire skeleton. The Losey mammoth was discovered about nine feet below the surface in the marl, below the water table. Mr. Hope, an accomplished sculptor and artist, could reconstruct the missing bones, but to make the complete, erect figure, he needed the skull, which was never found.

One of the great new discoveries that could occur any time in the Great Lakes area would be the finding of implements made by man, or the remains of an ancient campfire in close association with mammoth bones, indicating that man was in the area and had a nodding acquaintance with these great Pleistocene mammals. In the Southwest, such evidence has been found connecting the Columbian mammoth, a cousin of Michigan's Jefferson mammoth, and late Pleistocene man.

Perhaps in some future summer another spade will touch the red-brown remains of a giant jaw bone, or the crumbling white of a plaster-like tusk. "Dem bones, dem dry bones" are precious! The thing to do is to notify the experts, who will photograph the find and assist in further exploration. They know how the bones must be treated. The Losey bones were not petrified, and had to be kept moist until they could be treated with special preparations of alcohol and paraffin at the museum. The Michigan Historical Commission, Michigan Archaelogical Society, Michigan State University Museum, and the University of Michigan Museum are among the most active organizations in the State seeking the cooperation of laymen in such projects. Out-of-State, a safe course would be to notify similar institutions.

Scientists of Michigan State University willingly spend hours—which often stretch into months—with probe, pump, and shovel. A real find is most rewarding, not only to the workers but to a world that would like a fuller knowledge of its past.

BEQUEST

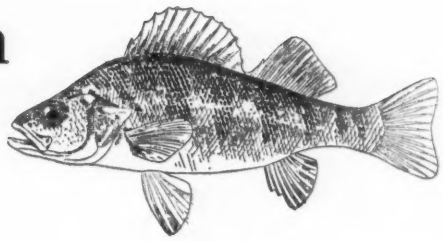
By Grace Shattuck Bail

Little wild creatures
Stagger and hurry;
Escaping the heat of
The forest fire's fury.

One weary raccoon
Has come to my farm;
Help me, St. Francis
To keep him from harm.

Succor all creatures,
Guide all safely here;
The opossum and squirrel,
The fox and the deer.

Some Common Perch and Bass



Yellow Perch

By E. LAURENCE PALMER

This is the 103rd of NATURE MAGAZINE'S *special educational inserts.*

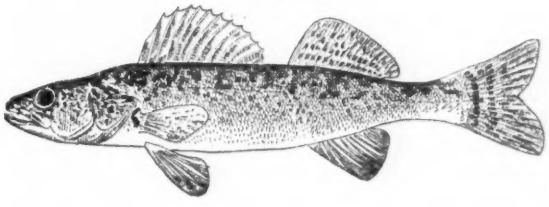
WHEN we read in the classic taxonomy of *Leviticus* 11 that we may eat "of all that are in the waters; whatsoever hath fins and scales in the waters, in the seas, and in the rivers, them shall ye eat," we about come to the end of Hebraic understanding of fishes in the time of Moses. Certainly, I find nothing in *The Bible* that indicates that any interest or understanding of perch and bass was evident in the thinking of the times. Even later, in Shakespeare's time, I find that this man's only reference to a "perch" refers not to a fish, but to a resting place. We can then dismiss our usually dependable Bible and Shakespeare as sources of understanding of the thinking of earlier peoples on the subject.

Izaak Walton was in his early twenties when Shakespeare went to his reward, and to many of us it seems unfortunate that Shakespeare had not had the benefit of some of Walton's mature philosophy. What a difference this might have made! But if the literature on bass and perch of three and a half centuries ago was meager, that of the present is extraordinarily rich. Scientific writers labor as to what we may call this fish or that, and popular writers publish checklists telling us what we may legitimately call our bass, perch and other fishes. As a college student forty-three years ago, I wrote one of my first scientific papers on the "Fishes of Okefenokee Swamp," which was published in 1920 in the Proceedings of the Iowa Academy of Science. Some twenty years later, in a doctorate examination, I had much fun discussing the genera of sunfishes with a man who is now a recognized authority on the classification of fishes. I am pleased to notice that, in a paper he published recently, he followed the philosophy to which I held, and with which he disagreed when we had that little examination. Surely our understanding of fishes will change greatly as time goes on, and I am pleased to have had at least a small part in relatively recent changes—although I may have little or no part in the changes that take place from now on!

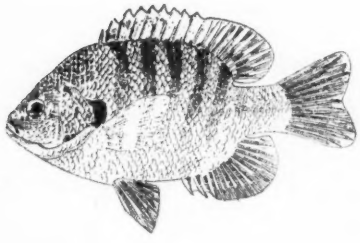
According to Berg's *Classification of Fishes*, the bass and perch we consider here belong to four families. The Centropomidae is represented in this article by the snook, *Centropomus unidecimalis*. The Serranidae is represented by the white bass, the white perch, and the striped bass. The Centrarchidae includes the sunfishes and bass of the average fresh-water fisherman's experience, comprising ten species in our list. The remaining four species belong to the Family Percidae, which has been divided into two families; the Percidae and the Etheostomidae, here considered as the Percidae, and including the yellow perch, the sauger, the log perch and the Johnny Darter. The first two belonged originally to the basic Family Percidae. All are in the Order Perciformes.

Of our four families, the following differences may be

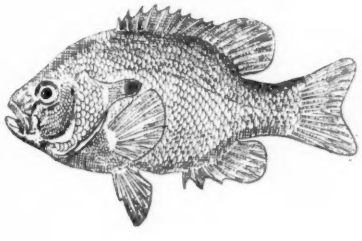
Sauger



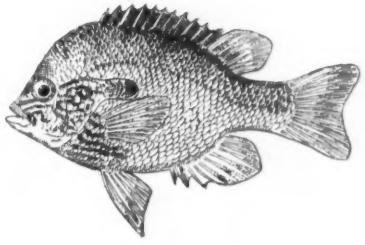
Bluegill

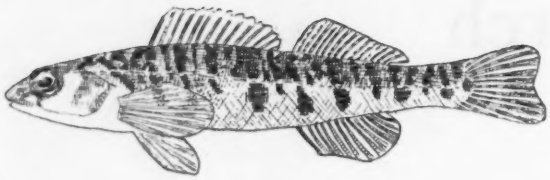


Yellowbelly Sunfish

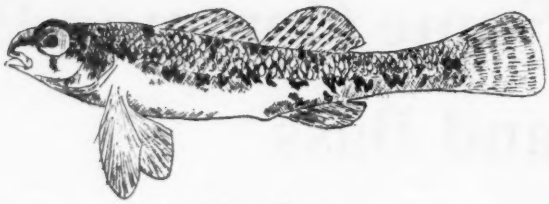


Longear Sunfish





Log Perch



Johnny Darter

recognized. In the Family Percidae, the anal fin has 1 or 2 spines. In the other families, this number is larger. In the Centropomidae, represented by the snook, the dorsal and anal fins have scaly sheaths and the lateral line extends to include the tail fin. This leaves us two families; the Serranidae, considered by some as the bass family, and the Centrarchidae, considered by some as the sunfish family. This Family Centrarchidae includes many species popularly known as bass, such as the black basses, the rock bass, and at least one fish popularly known as the Sacramento perch in California. It also includes the crappies. The bass family Serranidae includes, unfortunately for the average person, the white perch.

If we attempt to divide the fishes we consider here on the basis of where they are found, we immediately run into difficulties. Just as any attempt to separate these fishes on the basis of easily recognized structures is practically impossible, so attempts to divide them into fresh-water and salt-water and brackish-water forms face difficulties. Generally, of course, the sunfish family includes fresh-water forms. If we elect to call the members of the bass family the Serranidae, as the salt-water forms, we face confusion. The white perch is considered by some as marine, but it may enter rivers and brackish bays to breed, and some may become permanently landlocked. The white bass is essentially a fresh-water species, and the striped bass finds possibly its happiest existence in marine surf waters or running up streams at breeding time, sometimes going hundreds of miles from the sea.

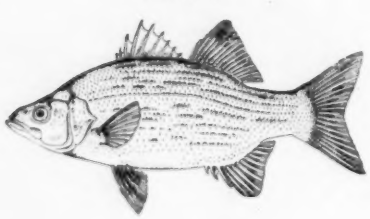
If these fishes migrate, this is primarily associated with breeding and calls for movements into fresh water or into shallow waters. Because of the popularity or economic importance of many of these fishes, widespread introductions of our bass and perch have been made. Through these introductions, the range of some of our fishes now extends from coast to coast where formerly it was more closely confined. Some have even been introduced and established in waters of other continents. In the list we consider here, the snook, as found in the United States, represents a fish with great natural range, as shown in the charts. We are hosts to these fishes in only a small portion of their northernmost range.

The size of the bass and perch varies greatly. A striped bass may exceed 150 pounds in weight and six feet in length, but a pigmy sunfish may reach a maximum length of one and a half inches. Even members of a common species may vary greatly in size, and it is not safe to say that a bass or perch of a given length or weight has necessarily reached sexual maturity. Size may be influenced greatly by competition for food supply among members of one or of many species, and fish management calls for the control of populations so that a given body of water may yield the optimum size and number of fishes. We have made remarkable strides in this field of fish study, with the result that more people may profit by association with these fishes—either by dinner plate, commercial net, or at the end of a line.

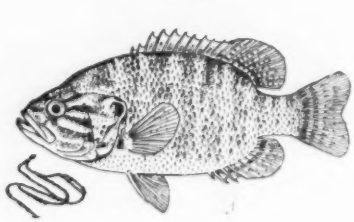
The story of the sex relationships of our perch and bass shows interesting variety. Members of the Serranidae may swim along in schools of considerable size, laying and fertilizing eggs, which may sink to the bottom or become attached to various supports. In general, they give no further attention to their offspring, which must shift for themselves from the beginning. We find a refinement of this procedure in the pike, perch and sauger group, where a number of amorous males accompany a female. Certainly any mass of eggs she may produce may be fertilized by a number of males. As is to be expected in such a situation, parental care is not practiced.

Family life in the perch that we consider varies greatly. In the yellow perch, the female swims along with the male and lays a strip of eggs in an accordion-pleated

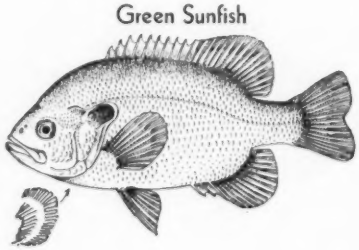
White Bass

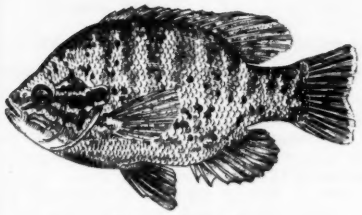


Warmouth

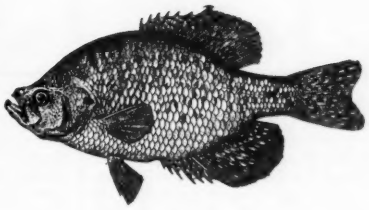


Green Sunfish

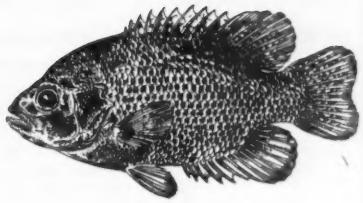




Pumpkinseed



Black Crappie



Rock Bass

band, which is spread over a mass of water plants. There they remain until they are hatched and the fry shift for themselves. In the relatively closely-related Johnny Darter of some of our brooks and streams, the male selects a nest site under a rock in flowing water. The female lays eggs on the roof of the bridal chamber, after which both leave their young to their fate. Some of these fishes may bury the fertilized eggs in sand or gravel, giving them a degree of protection from their enemies, but certainly not doing this at the risk of the parents' lives!

When we consider the Centrarchidae as a group, we find a different story. Here the male usually dominates the scene, and is the boss of the family. He may even do some things that seem to be the prerogative of the mother of the family. Usually the male selects and builds a nest where he wants it. Some species are secretive in this, while others build nests in a sort of community. Usually the bottom of the nest is so prepared that it may be kept free of suffocating silt by the actions of the male. The male may even take the eggs into his mouth, and expel them free of the dangerous silt. As a rule, the male guards the nest and eggs for which he is responsible. One cannot assume that all the eggs and young protected by a male have the same mother. In his ardor for a family, a male may bring more than one female into his nest, and she may visit the nests of more than one male before she quiets down for the year. By the time the young are able to find their own food and shelter, parental care as such usually ceases. While this procedure represents a relatively advanced stage in family life for fishes, it is by no means the highest if we consider all groups of fishes.

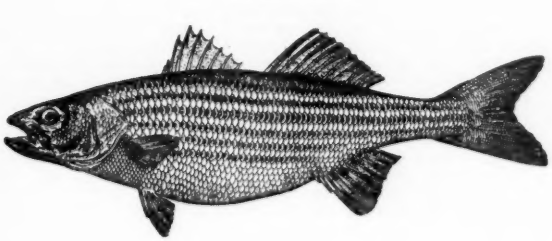
As a rule, egg-laying in the perch and basses is determined largely by the temperature of the water. Almost invariably it is determined at a point that is reached in a rising temperature and is not repeated when the temperature falls once more to that same low point.

It is surprising the extent to which fish behavior is determined by temperature. Successful fishermen often are guided not so much by luck as by the readings they find on their thermometers. Feeding, as well as breeding, are closely linked with the thermal situation as well as with the sexual status of the individuals involved. The dynamic activity of fishes also is often determined by temperature. For each kind of fish there is usually a band in the temperature range in which different activities take place. These bands are not the same for all fishes, of course. It is relatively common knowledge that the basses that are most active in cool, clear streams are more active fighters on the end of a line than are those species that live in warmer, more sluggish waters. Witness the type behavior of the active smallmouth bass found in warmer waters of sloughs and lakes. To some extent, this also is reflected in the vigorous behavior of the striped bass that may feed and be active in surf, and which may even be seen in a breaking wave.

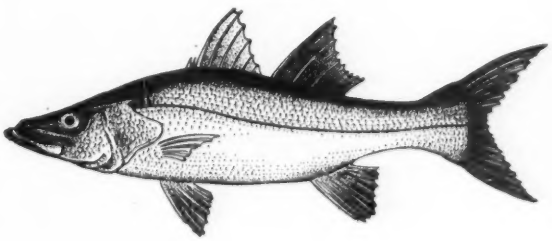
The food of the perch and basses may vary, but it is for the most part animal matter. Bluegill sunfish may feed in part on algae, but for the most part they feed on small aquatic animals. Since these small food animals are commonly found associated with water plants, the management of the plants may be just as important as the management of the animals that are the direct food for the bass or perch.

Structural differences in the fishes correspond in many ways to the nature of the food required. Some of our smaller sunfish that may feed on pond snails have sets of crushing teeth in the throat region that make it possible for them to find food value in animals that would be otherwise useless. The size and location of the mouth usually has an obvious relationship to the varying food requirements of our perch and basses. A small-mouthed yellow perch obviously cannot feed on fishes of a size that can be engulfed by the generous mouth of a large-mouth bass. Sometimes these (*Continued on page 480*)

Striped Bass



Snook

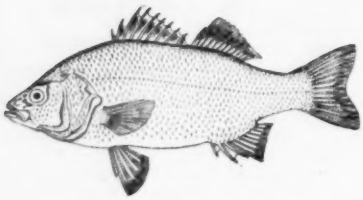


COMMON NAME SCIENTIFIC NAME	YELLOW PERCH *Perca flavescens*	SAUGER *Stizostedion canadense*	LOG PERCH *Percina caprodes*	JOHNNY DARTER *Boleosoma nigrum*
DESCRIPTION	Length to 19½ inches. Weight to 4¾ lbs. Sides olive with golden yellow and 6-8 dark, broad vertical bands. Lower fins orange, upper olive. 1st dorsal with 13 spines; 2nd separate with 14 soft rays. Anal fin with 2 spines and 7 soft rays. No black spot on spiny dorsal. Skin tough. Scales moderate with 55 in lateral line. Tail shallowly forked. Mouth terminal.	Length to 18 inches. (Related pike perch to 36 inches). Body with strong cross-bars. Lower lobe of tail white in pike perch and not white in sauger. No dark spot as basal part of a spiny dorsal fin but a dark spot in basal portion of pectoral fin. Two dorsal fins, the second with 18 soft rays and the 1st spiny. Anal fin with 2 spines and 12 soft rays. 95 scales lateral line.	Length to rarely more than 8 inches. Hog-like snout that extends beyond the upper lip. Mouth horizontal. With numerous narrow, dark cross-bars, sometimes joined, forming a row of spots along lateral line. Scales small, with about 100 in lateral line. 1st dorsal of 15 spines; 2nd of 15 soft rays. Anal fin with 2 spines and 9 soft rays. Nape is naked.	Length to 3 inches. Dorsal fins close together, the 1st of 9 spines and the 2nd of 10 to 13 soft rays. Anal fin with 1 spine and 8 soft rays. Lateral line nearly complete and of 45-52 scales. Cheeks are scaleless. Light straw-colored, with W or X markings along the middle of the body and fins more or less cross-hatched. Bones of upper jaw may protrude.
RANGE AND RELATIONSHIP	Family Percidae, including darters and pike perch. Found in fresh water lakes and streams often in or near vegetation from Lesser Slave Lake and Hudson Bay region to Great Slave Lake and south to South Dakota, Iowa, Illinois, Indiana, Ohio, Pennsylvania, New York and south to South Carolina. Introduced but not prosperous in western Texas and Okla.	Family Percidae, with the perch and darters. Related pike perch, *S. vitreum*, has lower lobe of tail whitish, no strong cross bars on side, pelvic fins widely separated by space equal to width of base of either fin, a dark spot at rear of spiny dorsal fin and no black spot on base of pectoral fin. Sauger found Vermont to Tennessee to Wyoming north into southern Canada.	Family Percidae, including perch and pike perch Commonest on rocky riffles or sandy bars or along sandy shores in lakes and medium rivers. Must swim hard to get to surface. Ranges through upper Mississippi areas to Churchill River in Saskatchewan east through Hudson Bay area to Quebec, south into Ohio River and Tennessee River systems and on to Ala.	Family Percidae, including the perch and pike perch. This species has a wide range from Saskatchewan south to Gulf of Mexico and east through drainage of Mississippi and Alabama, and north along Atlantic Coast to Maritime Canada. It haunts the bottom, usually in quiet water near swift water, and when disturbed may escape into the swift water.
REPRODUCTION	Spawn March-May in inshore waters at 44-54°F. Eggs in gray accordion-ribbon to 7 feet long, usually laid at night, 12-14 oz. Female lays to 48,000 eggs, which hatch in 27 days at 47°F. Young in schools at hatching, reach to 3 inches by fall; to 6 at 2 years; to 8 at 3; to 9½ at 4; to 10½ at 5; to 12″ and ½ pound at 6 years.	36-oz. female may lay to 83,000 unguarded eggs over shoals. In related pike perch spawning follows melting ice, usually upstream, with 4-6 males crowding single female, with water temperature of 42-40°F. 5 pound female lays to 128,000 1/12-inch adhesive eggs that hatch in 7 days at 57°F. into 3/16-inch fry which reach 7″ in 5 months; 12″ in 1 year; 5″in 2.	Spawns on sandy riffles or along lake shores in sand, with one female reported to have laid 3172 eggs, but 100 eggs per female is probably more common. May increase in length nearly ½ mm. per day during first month. At 2 years may be more than 3½ inches long. May rest motionless on bottom in exposed position, supported by pectoral fins.	Spawning takes place in May or June with the male resting under a flat rock while the female lays her eggs in a single scattered layer to the roof of the area under the stone. Female may lay to 340 eggs. The male gets darker while he stays by the eggs to give them protection. Male may become almost wholly black during breeding period.
ECOLOGY	Heart beat, 55-66 per minute. Requires .3 to 1.5 of parts oxygen per million of water. Can survive 39.2°F. for more than 24 hours and 89.6°F more than 66 hours. Average life span 3.4 years, with maximum to 13. A 24-ounce fish may yield 41 ounces of eggs. Food small animals such as insects, worms, crayfish and minnows.	Feeds best at 55-70°F. Food almost exclusively animal matter, largely other fishes when mature. May be parasitized by organisms that may become human parasites unless flesh is cooked thoroughly but ordinarily flesh is considered excellent food. Requires .3 to 1.5 parts of oxygen per million of water. Comes into shallows to feed at night and feeds under ice.	Obviously requires fresh water for survival. Feeds for the most part on small aquatic animals such as insect larvae, small crustaceans and minute shellfish. Is reputed by some to be a feeder on the eggs of more valuable species of fishes, but because of small size of mouth could not eat the larger eggs of some species.	Food is largely insect larvae, small crustaceans, possibly some fish eggs and some algae. Some species of darters bury their eggs in loose sands and gravels, and desert them quickly. The darters serve as food for other fishes, even including many of their close relatives, like pike perch.
ECONOMY	Excellent and popular food and game fish taken on hook and line. May take a fly and feed in schools, which make sport exciting. Netted commercially with 1½-inch mesh taking 5½-inch fish; 2½-inch mesh, 9 inch fish; and 2¾-inch mesh, 9.8-inch fish. Average catch of hook and line fisherman may be 4 to the hour, which is a rewarding experience to most fishermen.	Considered excellent food and game fish. Harvested commercially by netting. Nets with 2-inch mesh take 11-inch fish; 3-inch take 13 inch, and 4-inch mesh take 11-inch fish. In the forties a million pounds a year were harvested commercially in the Great Lakes, particularly in Lake Erie. Not taken by hook and line commercially because swims deeply.	Has a deserved reputation as being a stealer of bait from hooks, and because of small mouth is not commonly taken on a baited hook such as is commonly used. Has been used as a bait minnow, but does not survive long in the usual minnow bucket, probably because of oxygen needs.	Johnny darters are hardly of any great economic importance, but are always interesting to observe free in the waterways or in aquaria, although they do not adjust readily to aquarium life and usually are short lived if forced into such an existence.

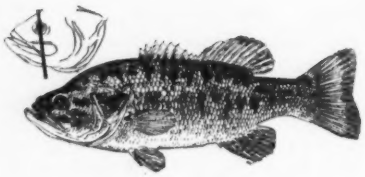
SMALLMOUTH BASS *Micropterus dolomieu*	LARGEMOUTH BLACK BASS *Micropterus salmoides*	GREEN SUNFISH *Lepomis cyanellus*	YELLOWBELLY SUNFISH *Lepomis auritus*	LONGEAR SUNFISH *Lepomis megalotis*
Length to about 2 feet. Weight to 7 pounds. Rear of jaw to vertical dropped through eye pupil. No clearly defined lateral band. 1st dorsal of 14 spines; 2nd of 13-15 soft rays. Anal with 3 spines and 10 soft rays. Sides of young with vertical bar or broad light-centered blotches. Lateral line with 69-77 scales, smaller than in blotched and largemouth basses.	Length to about 3 feet. Weight to more than 20 pounds. Rear of mouth extends to behind vertical dropped from pupil of eye. Dark band clearly marked on sides. No vertical dark bars. 1st dorsal with 10 spines, the shortest being less than ½ length of the longest; 2nd 13 soft rays. Anal fin with 3 spines and 11 soft rays. 58-69 scales in lateral line. 7-12 lb.	Length to 7 inches. Dorsal fin of 10 spines and 11 soft rays. Anal of 3 spines and 9 soft rays. Lateral line has 43-55 scales. Overall olive-green to yellow on the belly. Pectoral fins are short and rounded as against the pointed pectorals of the bluegill, and the mouth of the green is large as contrasted with the small mouth of the bluegill. Body is thick.	Length to 1 foot. Weight to more than 1 pound. Most conspicuous because of long, narrow, black earflap. Dark olive to blue with light underparts that are yellow and red during spawning season. Some may show a hump in front of the dorsal fin. Bluish stripes on head and scales of sides with blue spots. Gill rakers short, hard and stiff.	A 6-inch, 5-year-old Oklahoma fish weighed 2½ ounces. Known to reach 8 inches in Mississippi River. Dorsal fin low without black spot. Wide, long earflap with varicolored border. Body short, deep, colored with bright blue streaks. Pectoral fin short, rounded and dusky, 13-15 rays Breeding male one of the most beautiful of fishes.
Family Centrarchidae, including basses and sunfishes. Closely related to largemouth and spotted basses, both having larger scales and fewer dorsal soft rays. In smallmouth, the shortest dorsal spine is more than ½ the length of the longest. Thrives in clear cool streams and lakes. Formerly limited mostly to Great Lakes but now found in all States and in Canada.	Family Centrarchidae, related to basses and sunfishes, and closely related to spotted or Kentucky bass, *M. punctulatus*, which was recognized as a distinct species in 1927 and has evenly arranged black spots alternately below dark lateral line. Largemouth ranges from Manitoba to New York and south to Florida and Mexico, and is widely introduced.	Family Centrachidae, with the basses and other sunfishes. This species was formerly classified under the genus *Apomotis*. The species has long gill rakers and the opercle on the side of the head is stiff to the margin. Green sunfish and bluegills may hybridize freely given the opportunity. Species favors sluggish creeks and ponds and small lakes.	Family Centrarchidae, including the basses and sunfishes. This is the largest genus of sunfishes including at least 10 species. This species known also as redbreast sunfish, red brim and robin. See also green, longear, bluegill and pumpkinseed sunfishes. Yellowbelly ranges from Maine to Florida and along coast and into Texas west to Lake Ontario.	Family Centrarchidae, including sunfishes and bass. This species formerly included in genus *Xenotis*. Many subspecies with geographic limitations. As a rule the species is considered eastern. Great Lakes forms have broad red border on rear of earflap and are smaller (to 4 inches). Mississippi form has earflap bordered with light blue. Minnesota, to Mexico.
Male builds nest over coarse sand or rock in water 3-6 feet deep at 59-65°F. May-June. At 65°F. females may lay 7000 per pound of her weight. Nest and eggs guarded by male. Young with conspicuous black band across tail but no large lateral stripe. At 5 months, to 3 inches; at year, to 5; at 2 years, to 8. 12-inch fish weighs 1 pound; 15-inch, 2; 20, 4; 22¼-inch. 10¾	Spawns first in 2nd or 3rd season, in male-built nest several feet from other nests. Spawns at 60-65° F. with female laying 2000 to 5000 eggs per pound of her weight. Average nest may have 4-5000 fry which are protected by male until 1 inch long. Under ideal conditions may reach 8 inches 1st year and weigh to 2 pounds in 3 years. Growth begins at 80° F.	Spawning takes place in April to late July in a nest made by male over sand or clay bottom, and is protected by the male. This nest is commonly made in creeks because this species may haunt creeks at breeding time. It favors silty bottoms and sluggish current. It is found from coast to coast due in part to introductions.	May build many nests relatively close together, usually in sluggish streams but often in relatively fast water over sand or gravel bars. Tolerates current better than many sunfish. Nest built by male. A 5.3-inch (?) Texas fish weighed 1.9 ounces and a 9.4-inch 8-year Connecticut fish weighed 11 ounces.	Spawning takes place in May and June, usually at a temperature of about 78°F. Nest is on gravel 5-20 inches under water and 1-2 feet in diameter. Male guards nest but does not bite baited hook readily when on guard. Nests may be in groups, guarded until August. At 1 year, 1.4 inches; at 2, 3.2; at 3, 4.7; at 4, 5.4; at 5, 6½; at 6, 6.7; at 7, 2¼ oz.
Food largely small aquatic animals but may take mice and reasonably large fish. Do not grow in winter but may begin to feed at 39°F. Below 52°F., bass may bite best at mid-day. Favorite feeding temperature is about 67° F. and when water gets above this bass seek cooler depths. Thus, in average lake with surface temperature of 70-78°, bass feed deeply.	Food largely animals including fish, frogs, crayfish, mice, moles, ducklings, worms and leeches, and of course many kinds of insects and some mollusks. Favors more weedy areas than do the smallmouth bass. Can survive temperature of to 93° F. for to 72 hours. Bite most readily at 65-73° F. Hatch in 14 days at 64-70°F	Food, like that of other of its relatives, is largely small aquatic animals including insects, worms and probably little fishes where they are available in suitable size. The fish is popular because of its beauty, being olive above to yellow or copper below, and each scale has a spot of brilliant green, the spots forming sometimes obscure horizontal lines.	Food for the most part is small animals to be found in environment and includes small fish, insects, worms, mollusks and crustacea taken while alive. While this is an eastern species for the most part it can be found to New Brunswick on the coast and north to Oklahoma in the Mississippi Valley.	Food is essentially small aquatic animals such as insect adults and larvae, worms, crustaceans, mollusks and the like. May feed extensively on leeches. Taken most commonly on a worm-baited hook, but may take an artificial fly on occasion. The relatively small mouth makes a small hook essential in successful bait fishing.
Of top popularity as fresh-water sport fish because of vigorous fighting ability. Superior food fish but do not match trout here. May compete with trout and salmon for suitable habitat. Because of favoring cool waters, are not so commonly cultured with bluegills as are largemouth bass, but if waters are too cold growth is unsuitably low.	Provides superior sport but does not leap from water or fight as vigorously as do smallmouth bass. Cultured in fish ponds widely, using combination with bluegill sunfish with bass to keep bluegill population down and bluegill to feed the bass. Properly managed, a pond may yield to 200 pounds of fish per acre the first year. Best stocked in spring.	This species is a good pan fish and takes a worm-baited hook readily. Because of its favoring shallow waters of ponds and creeks it is a popular species with boys and with beginning fishermen of either sex. Some fish are kept in captivity in aquaria. One captive green sunfish lived for 7½ years under these conditions.	A beautiful and popular fish, but not so well known as some other species and not cultivated in ponds as are the bluegills and their hybrids. It is a good pan fish popular with fishermen.	This small fish is an aggressive fighter and therefore popular with fishermen, particularly with those who learn how to take it with a fly. Their range, in quiet portions of large streams and only now and then in small headwater streams, puts them in competition with larger, more favored species of game fishes.

COMMON NAME SCIENTIFIC NAME	BLUEGILL. POND PERCH *Lepomis macrochirus*	PUMPKINSEED *Lepomis gibbosus*	WARMOUTH *Chaenobryttus coronarius*	ROCK BASS. GOGGLE EYE *Ambloplites rupestris*
DESCRIPTION	Length to more than 1 foot. Record weight 4¾ pounds. Dark, with large dark earflap and dusky spot on rear of soft dorsal. Usually with 5-8 dark vertical side bars. Gill rakers long, more than 2 times width of base. Anal fin with 3 spines and 10-12 soft rays. Basic color olive green, with blue and orange on body. Colors fade rapidly at death of fish.	Length to 11 inches. Weight to 1½ pounds. Dorsal with 10 spines and 11 soft rays. Anal with 3 spines and 10 soft rays. Lateral line with about 47 scales. Cheeks with wavy blue streaks. Opercle with large red spot. Dark blue earflap. Orange spots on sides. Breast yellow or orange. Eye large. No teeth on palate. Pectoral fin forward.	Length to more than 10 inches. Weight to 1½ pounds or more. Dorsal fin with 10 spines and 10 soft rays. Anal fin with 3 spines and 9 soft rays. About 40 scales in lateral line. Olive to gray, and without regular dark streaks on sides characteristic of rock bass. Sometimes mottled golden brown, with green to yellow breast and belly. Teeth on tongue. Mouth wide.	Length to 14 inches. Weight to 2 pounds. Dorsal with 11 spines and 10 soft rays. Anal with 6 spines and 10 soft rays. Lateral line with about 40 scales. Greenish olive, with each scale with rectangular dark spot. Can change color quickly from almost black to light green or olive with dark spots. Eye red and large of the goggle" type. Mouth large.
RANGE AND RELATIONSHIP	Family Centrarchidae, with other sunfishes and bass. This species once considered in genus *Helioperca*, and may be known as dollardee, copper-nosed bream and brim. Best known of all sunfishes and most widely cultivated. Ranges from Lake Champlain to Oregon and south to Mexico. Planted widely. Common in rearing-farm ponds.	Family Centrarchidae, with other sunfishes and basses. This species was formerly considered as belonging to the genus *Eupomitis*. Not native on Pacific Coast but now established there widely from British Columbia through Oregon. Native from the Dakotas and adjacent Canada south through western Mississippi system east to the Atlantic.	Family Centrarchidae, which includes sunfishes and basses. Closely related to rock bass which has 6 instead of 3 anal spines and which has regular dark streaks along the sides. This species ranges from Minnesota to New York and Pennsylvania and south to Florida and the Rio Grande. It shares habitat with superior food and game species. Introduced on Pacific.	Family Centrarchidae, including the sunfishes and basses. In spite of common name this is a sunfish. It is found in a variety of waters determined in part possibly by competition with other species. May congregate in large numbers in deep holes. Ranges from St. Lawrence system and Great Lakes and south through the Mississippi system to the Gulf Coast.
REPRODUCTION	May mature in 1 year, breeding at 2-inch length. Spawns May to September at 80°F., and under ideal conditions may grow in Illinois from .8-6.45 inches from June to October. Growth limited to 60-80°F. period. Species hybridizes freely with pumpkinseed, green and redear sunfishes. Several broods a year raised in colonial male-guarded nests to 2 feet across.	Male builds nest in weeds on gravel, usually in sunlit, rather shallow water. May have plant-root base in nest. Breeding at 68°F. Nest to 1 foot across, and protected vigorously by male. May hybridize freely with bluegill and with green sunfish or with other sunfish, with the hybrids often larger than either parent species.	Male builds nest in early spring or summer and gives it some defense. A 9-inch fish may weigh to 10 ounces. Species may hybridize freely with other sunfish that adopt similar nesting areas, even with species that have superior food and sport value. In controlled ponds has low reproductive capacity and may be stunted with any crowding.	Spawns around May or June in nests built by male in gravel or sand, usually near water weeds. One female may lay 11,000 eggs. One rock bass reared in captivity lived 12 years and another 18 years. Average growth equals 2 inches 1st year; 5 in 3; 6 in 5; and by 7 may weigh ¼ pound. An 11-inch fish should weigh about 1 pound.
ECOLOGY	Food largely aquatic insects, small crustaceans, mollusks and smaller fishes, as well as some vegetation. Commonly managed to work with largemouth bass, with bluegill feeding bass and providing sport and bass controlling bluegill population to permit development of larger fish. Bluegill are common in or near aquatic vegetation or in deep pools in streams.	Feeds largely on aquatic insects and their larvae, with crustaceans and with mollusks, whose shells may be crushed in the throat. It favors earthworms and is an expert at getting one off a baited hook without fatal consequences. The species can survive water temperatures of more than 82° F., and requires about .9 part per million of oxygen in the water.	Food is largely that of other sunfishes including insects, worms, mollusks, crustaceans of suitable size and availability. May be found in sluggish, weedy streams over soft, muddy bottom. Requires .3-.5 parts of oxygen per million of water. Growth may be slow and an 8-inch fish may be 6 years old, while a bluegill may reach that length in a few months.	Food is insects, crayfish, worms and to some extent other smaller fishes. It may compete seriously with the more valuable smallmouth bass that might well share the environment. May feed extensively at night. May be parasitized by the bass tapeworm. With age the scales become smooth at about 6 years.
ECONOMY	Under proper and ideal management a pond may yield to 300,000 fish per acre the first year or 600 pounds of fish per acre counting all sizes. Usually stock pond with 100 largemouth bass to 800-1500 2-inch bluegills per acre, stocking in early season. Water must have oxygen at .6-.8 parts per million. Bluegill sometimes used in combination with trout.	Will take a fly, and provides excellent sport for young fishermen and excellent food for anyone when fried crisp. It is most commonly taken on a baited hook. In winter many die in frozen-over ponds when snow cuts off light and prevents normal plant growth and normal release of oxygen that supports animal life.	An inferior game fish so far as food value is concerned, but is popular because under some circumstances it may take a fly readily. It also takes a baited hook readily but it lacks the verve enjoyed so much by sports fishermen. Flesh may taste muddy.	A popular bait-taken fish feeding freely on grasshoppers, worms, white grubs and minnows. May be netted commercially with 1½-inch mesh taking 3½-inch fish, 3-inch mesh taking 7-inch fish, and 4-inch mesh taking 9½-inch fish. Considered a good food species, particularly as contrasted with mud-haunting warmouth.

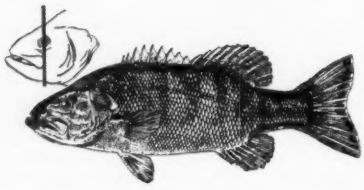
BLACK CRAPPIE CALICO BASS *Pomoxis nigromaculatus*	SNOOK, ROBALO, SERGEANT FISH *Centropomus unidecimalis*	STRIPED BASS *Roccus saxatalis*	WHITE BASS *Roccus* or *Lepibema chrysops*	WHITE PERCH *Roccus americanus*
Length to more than 1 foot. Weight to 2 pounds. Dorsal fin with 7-8 spines and 15 soft rays. Anal fin with 6 spines and 17 soft rays. Lateral line with about 41 scales. Length of the dorsal fin base about equals distance from eye to base of the dorsal. Color variable, silvery, marked with dark green. Fins that are not paired are conspicuously spotted.	Length to 4½ feet. Weight to more than 50 pounds. Dorsal and anal fins each with scaly basal sheaths. Lateral line conspicuously dark and extends on base of tail fin. Mouth large with projecting lower jaw. Top of head profile concave. Tail forked. Sides silvery, with purplish iridescence. Under parts white. Dorsal fins black or dusky and some fins whitish.	Length to more than 6 feet. Weight to 125 pounds. 1st dorsal with 9 spines, 2nd with 1 spine and 12 soft rays. Anal fin with 3 spines and 11 soft rays. 2nd anal spine 5 times in head and shorter than the 3rd. Dorsal fins separate. Sides with longitudinal dark stripes, unlike plain sides of related white perch. Lateral line does not extend onto the tail.	Length to 1½ feet. Weight to 1½ pounds. 1st dorsal with 9 spines; 2nd with 1 spine and 14 soft rays. Anal with 3 spines and 11-13 soft rays. Lateral line with about 55 scales. Greenish silvery on the sides and striped or plain silver. Body compressed and base of tongue with one patch of teeth. Back is arched and body deep. 2nd anal spine 1/3 length of the head.	Length to more than 1 foot. Weight to about 6 pounds. Dorsal fins two, 1st with 9 spines, 2nd with 1 spine and 12 soft rays. Anal with 3 spines and 8-10 soft rays. 2nd anal spine about equal to the 3rd. Longest dorsal spine about ½ head length. Sides marked with streaks that are sometimes hardly visible. Dark green above and silvery to olive beneath.
Family Centrarchidae, which includes sunfishes and bass. Genus includes the black crappie which usually has 7 or 8 spines and the white crappie, *P. annularis*, which usually has 6 spines in the dorsal fin. Black crappie ranges through the upper Mississippi Valley and the Great Lakes area south to Florida and Texas, farther north than does the white.	Family Centropomidae, represented in United States by one species and one genus that is found along coast of Gulf of Mexico and Florida. Relatives (about 8 species) extend range to include both coasts of Central and South America north to Baja California and in tropical Africa, Indian Ocean and western Pacific. Related genus, *Lates*, is found in Asia.	Family Serranidae, which includes the genus *Roccus*, including the striped bass and the white bass, and the genus *Morone*, which includes the white perch and the yellow bass. In *Roccus*, the dorsal fins are separate; in *Morone* they are connected. Striped bass essentially marine but runs up rivers and bays to breed. New Brunswick to Florida.	Family Serranidae. Formerly considered as a member of Moronidae, the river basses, but now considered a sea bass although it may not be marine. Closely related to yellow bass but the dorsal fins are separate in the white bass and joined in the yellow and the 2nd anal spine is shorter than the 3rd in the white bass. Ranges from New Brunswick to Mexico	Family Serranidae. Formerly considered as in Family Moronidae, which includes the river basses. Most closely related to yellow bass, *Morone interrupta*, which has the longest dorsal spine—more than ½ head length—and has the dorsal fins only slightly connected. Found from Nova Scotia to Florida and in most of the Atlantic Coast States.
In late spring or early summer the male selects a nest site, builds a nest like other sunfish. 1½-pound female may lay 140,000 eggs and a ½-pound fish may lay 20-60,000 eggs. Young may be 3½ inches long at 1 year, 5 at 2; 8 at 4; and 12 at 7 when the weight may reach 1 pound. Nests made in water 3 to 8 feet deep. Spawns at 65°F.	Movements into bays and inlets are not necessarily associated with breeding, and abundance in an area is not necessarily seasonal or associated with reproduction. Comparatively little is known about the reproduction story. The schooling habit sometimes obvious in Florida in early summer may or may not be associated with reproduction.	Spawns April-May in North Carolina and in July in Gulf of St. Lawrence. Most fish more than 30 pounds are females. A large female may yield 1,215,000 nonadhesive eggs, but a small 4½-pound fish may yield 265,000 semibuoyant eggs that swell from 1.3 to 3.6 mm. when laid, hatch in 30 hours at 71°F., and in 70-74 hours at 58-60°F.	In April or earlier spawning takes place in shallow, flowing water among rocks or in riffles with no nest and no parental care. A female can produce more than 500,000 eggs. Eggs hatch in 2 days at 60°F., and young grow rapidly. Males breed at 2 years and 8 inches; females at 3 years and 11 inches, often spawning at night. 12 inches by 2nd year; 1 pound, 13 in. by 5th.	Run upstream to spawn in April or May, leaving salt or brackish water. Eggs are scattered and are given no care by parents. Eggs about .73 mm. in diameter and with large oil globule, hatch in 6 days at 52°F. Lake spawning may be as late as July. Eggs stick to objects with which they come in contact. Known to live to more than 14 years. To 4 in. long 1st fall.
Food largely aquatic animals such as insects, worms and crustacea. Requires .3-.4 parts of oxygen per million parts of water. Under management a pond may produce 30,000 fish per acre the first year but because of enormous reproduction and crowding the growth of fish may be retarded because of competition for food. Best temperature at 75°F.	Food largely shrimp, free-swimming crabs and small fishes. In spite of the fact that they haunt pilings, they do not pull oysters and shellfish from such supports, nor do they feed on large fishes. To the angler they are intriguing because of their vigorous taking of baits, natural and artificial, and their acrobatics when once hooked.	Feed in schools, often close to shore in breaking surf. 1-year fish is to 8 inches long; 2-year to 11½-inches; 7-year to 20 pounds; 18 year to 50 pounds. Active in water from 43-75°F., but probably does not survive at more than 80°F. At home in water with salinity down to 3.3%. Breeds at 2-3 years for males; at 4-5 years for females.	Feed largely on smaller animals with gizzard shad a favored species for the adults. Feeding may take place when large schools of gizzard shad are to be found near the surface, and this feeding creates a disturbance that may be seen for some distance. Breaking surf churns the sea bottom and disturbs life which is the major food.	Food mostly small invertebrates in earlier stages, but later feed largely on other fish. May feed freely on small smallmouth bass, minnows and perch. May feed near the surface, particularly at or near night-time, and move into shallow water for this purpose when the sun is low. When sun is high may be found in deeper waters.
By plantings, range has been extended from Manitoba to Connecticut and to California. It must have room to thrive. Fish commonly move into shallows to feed at night, and in fall go down to the depths for the winter. Not an aggressive fighter but a good species and a popular species for the bait fisherman.	Sport fishermen in the United States in a relatively limited area harvest annually at least 500,000 pounds. Fishing is done with artificial plugs or with live baits, the latter commonly suspended from 1-3 feet below the water surface. The flesh is superior in every way and is eaten fresh, smoked or preserved. Sports writers seem to find great joy in writing of snook.	Considered by many as the king of all food and game fishes. In some States it can be taken legally only by hook and line, with not more than two hooks to a line. So valuable is the species that commercial and sport fishermen have conflicting interests; commercial seiners have sometimes been serious problems, but the species must be protected for all.	So valuable is this fish to commercial fishermen and to sportsmen that they sometimes have conflicting interests and views regarding capture methods. White bass deserve recognition as top sport fish and laws governing their capture are gradually improving, and may lead to increase in this natural and recreational food resource.	Chesapeake Bay may yield 900 tons a year. May be reared in ponds, but are so prolific ponds must be managed to prevent stunting. Average growth may be 3 inches at 1 year; 4 at 2; 5 at 3; 6 at 4; 8 or ½ pound at 8 years. This fish is called sea perch, silver perch and river bass, but it is a bass and not a true perch.



White Perch



Largemouth Bass



Smallmouth Bass

(*Continued from page 475*)

conflicting food interests seriously impair man's interest in such fishes. White perch that inhabit waters in which smallmouth bass live may feed freely on these popular game fishes, particularly on their young. In cases of this sort humans who manage the economy of a waterway must be prepared to make decisions and to stand by them. Fishermen who use baits to lure their fishes recognize great variations in the forms that are most successful. Often, however, success in catching bass and perch on baited hooks depends mostly on the skill of the fisherman in placing his bait where it should be placed. To the fishermen it is academic as to what it is that determines the action of the fish. Just visit a fishing tackle shop to see some of the fantastic gadgets that have been developed to get a bass or a perch to take a hook, or visit any news stand to see the abundance of literature good and bad that is available to the guy who must for one of many reasons get his fishing vicariously or read to improve his chances of getting a fish when the opportunity may come. I doubt, however, if anything can equal the experience one gets as a youngster trying to catch "just one fish" with whatever tackle he may have. In my grandfathers' barns on both sides of the family there were rafters that supported cane fishing poles with lines and hooks wound about them. These saw action a relatively few times a year, but they were as much a part of rural life as was the cider barrel or the organ in the parlor. I, for one, cannot picture the barns on either of the farms of my grandparents without seeing those cane poles.

I know it may be cause for mayhem, but I can honestly say that, as I grew up and became interested in trout fishing, my interest in bass and perch waned. It is still waning, except when the situation calls for bass fishing. My graduate program in college called for close adherence to my studies, but I found time to grab a few minutes at the end of many days to retire to a creek-fed lake and cast some trout flies in the swift water at the head of the lake. There I usually found little smallmouth bass, too small to be kept legally, but an enormous amount of fun to catch. They helped clear many a cobweb after a day's work over a microscope. I owe them a debt of gratitude for helping me be a reasonable person, I hope.

It is idle to speculate about what fish is the most beautiful of all fishes. I have doubted if any could equal a freshly caught brook trout, but then again I have doubted that even a trout could match the glory of a common pumpkinseed in full breeding color. If you live within the range of that species and can get a stick, a piece of string, a hook and almost any small animal bait, you will be able to see what I mean, because almost anyone can catch a pumpkinseed. Ounce for ounce, I am sure no trout can beat that diminutive sunfish, either for pure beauty, for exuberant living or for fighting ability when its freedom is threatened. When the trout is in the frying pan it does not "smell up the house" the way any of the bass do, nor do they equal each other when it comes to eating. I know of nothing more palatable than a nine-inch brook trout fried in butter. Some of you may differ with me on this, but if so, you are entitled to your own opinion. I would like to put the two fishes properly cooked before any neutral judge of good eating. I have every confidence that my faith in the trout would win out!

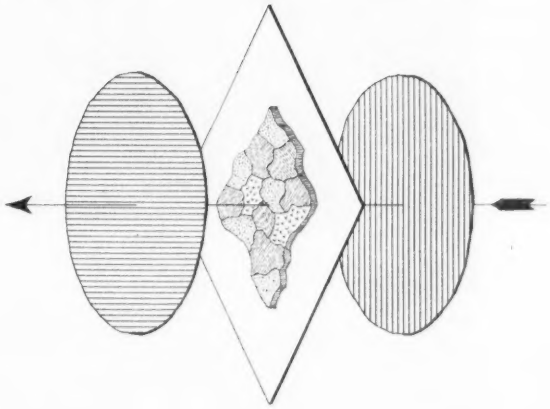
I know a retired college professor who finds great rewards in simply catching large bass. He rarely kills a fish, but he removes a scale from those he can handle and keeps a record in a notebook of the time, place and bait used in the "contest." The scale is filed with the record and indicates the age of the animal. He gets a satisfying experience from the routine he follows.

Where lies the real value of our association with these fishes? Does it lie in the ability to prepare the carcass as a tidbit to be served with a meal? I doubt it. Does it lie in an ability to catch more and bigger fish than one's associates? I doubt that, too, in spite of the obvious merit to be found there. I question if it lies in one's ability to paint or photograph the beauties of these fish, although that has its points. Does it involve an understanding of the management of the waters in which they live, to the end that they may prosper and be even more rewarding? Is it dependent on one's ability to provide the fishes with more and better food, to relieve them of the limitations on their development caused by their parasites or the predations of their enemies? Does it involve a thorough understanding of their life histories to the end that their management may be simplified? Does it involve improvement in the making and enforcement of laws dealing with factors that inhibit their prosperity—such as those associated with pollution, unlawful netting, disturbance of breeding sites and dangerous temperature changes of the water? I doubt if the answer lies in any one of these; but taken together, I am sure that the fishes and their associated problems offer us a lifetime of rewarding challenges. They help make our lives interesting!

Kaleidoscopic Rocks

By RICHARD L. THREET

Illustration by the Author



Illustrated is an "exploded" view of materials for the kaleidoscopic projection of polarization interference colors. A thin chip of rock such as granite—cemented to slide binding glass—is sandwiched between pieces of Polaroid with crossed axes of polarization and inserted into an ordinary slide projector, as with a conventional color slide.

WHO HAS not been fascinated by the endless variety of kaleidoscopic patterns formed by mirrors and bits of colored glass? But without mirrors, and with nothing more than a transparent chip or rock and two disks of Polaroid, your slide projector can become a kaleidoscope that rivals the best.

Roughly a century ago, a pioneer petrographer named Sorby developed a technique for grinding transparent "thin sections" for microscopic study of most rocks and minerals. At about the same time, Nicol developed a special type of calcite prism for producing polarized light. Other types of polarizing devices also have been developed, but it was not until Polaroid was discovered that the phenomena of polarized light could be studied widely outside specialized laboratories of physical optics.

It has been found that many crystalline minerals in ordinary rocks exhibit birefringence, a non-uniform transmission of polarized light that results in light wave interference and the production of a variety of colors, depending on thickness of the mineral chip and orientation of the crystal lattice. When a chip of rock is ground to some standard thickness—usually only a few hundredths of a millimeter—the respective polarization interference colors produced can be related to mineral composition. This system of optical mineralogy is highly useful in geology and petrography for the identification of undetermined minerals.

For "rockhounds" and others interested in beautiful and unusual features of rocks and minerals, these polarization colors can be the basis of some striking displays or "color" slides for projection. If you have access to a diamond-edged rock saw and some abrasive laps, you can prepare your own thin sections of various rocks quite easily and quickly. Saw a chip of rock about an inch in diameter and about one-sixteenth of an inch thick. Smooth and polish one face of the chip on an abrasive lap, and cement that face to a color slide mounting glass, using Canada balsam or "Lakeside" cement available from most lapidary supply houses. Holding the mounted chip face down against an abrasive lap, grind the chip as thin as possible; most rocks become highly transparent. Wash off all abrasive grit and cement another slide glass over the chip; bind the two glasses with tape, as with any ordinary projection slide.

If you do not have lapidary equipment, you can obtain prepared thin sections from some scientific supply houses, or you can have thin sections made from your own rocks by commercial preparators found at most large university departments of geology or mineralogy. Coarse-grained rocks such as granite, gneiss, gabbro, and quartzite give spectacular results. One of the most colorful "kaleidoscopic rocks" is dunite, or peridotite, ground to a very thin section.

When the thin section has been prepared, sandwich it between two disks or squares of Polaroid that have been oriented with their directions of polarization mutually perpendicular (see diagram above), and insert this sandwich into the slide carrier of a projector. If the slide carrier can not accommodate such thick sandwiches, place one Polaroid filter between the projector lamp and the slide carrier, and hold the other Polaroid filter (in the crossed position) in front of the projector lens. The brilliantly colorful mosaic that you will see can be varied by rotating the crossed Polaroid filters about the projection axis. Some projectors can be adapted to permit rotation of the Polaroid filters continuously during projection, thus giving a true kaleidoscopic effect.

If you can not wait to try this colorful projection trick with rock thin sections, just stick bits of cellophane tape in random fashion on a slide binding glass. The cellophane material is birefringent. That is, like many of the crystals in rocks, it splits polarized light into various frequencies that interfere to cancel out certain wavelengths and give appropriate colors, and will give you a chance to create artistic mosaics of infinite variety and fascination.

Silently paddled canoes enable young students at the Maine Sportsmen's Conservation School, in the deep woods of the township of Ellsworth, Maine, to get a close look at wildlife on a bog stream.

Deep in the woods of Maine,
a school for youngsters is

Planting the Good Seed

By BILL GEAGAN

No prepared "mixes" are used in the outdoor cooking area, that important and popular place where the students must ready their own ingredients for biscuits and cookies.

COMPLETELY convinced that "an old dog cannot be taught new tricks," and that if Maine's great outdoors was to be preserved it would be a job for the youth of the State, the Penobscot County Conservation Association decided to do something about it.

The Association's president, Victor Viola of Bangor, led the way. That was nine years ago; and today Maine has, in the widely acclaimed Maine Sportsmen's Junior Conservation School, what is believed to be an institution unique in the nation.

Roland Chandler, executive secretary of the Bangor Young Men's Christian Association, was called in. Long an outstanding builder of boys, he was enthusiastically cooperative. The site for the school would be the old and widely known boys' camp, Camp Jordan, operated by the "Y," deep in the woods on the shore of big Branch Lake, in the township of Ellsworth. When the regular summer season ended, the school would take over in early August. The project would be tried for one week. Those were the plans.

The camp would be donated. The camp director,

Bill Bennett; camp mother, Mrs. Bennett; the kitchen staff, nurse, and several of the older counselors would be retained at their regular salaries, to be paid by the Association. That was fair enough, and Viola turned to the problem he feared most—that of finding for the various classes suitable instructors who would be interested enough to donate their time.

He found them, finally; woods guides, log-drive cooks, professors at the University of Maine, doctors and survival experts stationed at the Dow Air Force Base in Bangor, and Fish and Game Department wardens. I was glad to join the faculty as instructor in Nature and Conservation. Those were to be the principal subjects in the curriculum. They were the basic purpose of the school.

The other subjects included outdoor cooking and axe handling, canoe and boat handling, map and compass reading, pioneering, fly and bait casting, swimming, first aid, and target shooting competition with bow and arrow and small-bore rifle.

The purpose of the school was to give the young students, from 12 to 17, a well-rounded education in outdoor living, to instill in them the importance and value of a priceless natural heritage, and to show them how to protect it.

News of this unique project spread rapidly. Sharing the enthusiasm, the National Wildlife Federation, of Washington, D. C., made a grant of $900 to help in getting the project under way. Those extra dollars were put to very good use in the purchase of additional equipment and T-shirts and sweat-shirts bearing the name of the school, to be worn by students and instructors.

The tuition for that first week was only twenty dollars, including insurance. Enrollment was limited to one hundred boys. They came in all shapes and sizes, from all walks of life and all parts of the State. They were sponsored by parents, business houses, newspapers, bird clubs, and other organizations.

The experiment was a complete success, and today, nine years later, this school in the woods is enjoying tremendous popularity and suffering with growing pains. Because of present-day economic conditions it has been necessary gradually to increase the tuition fee from twenty to twenty-eight dollars.

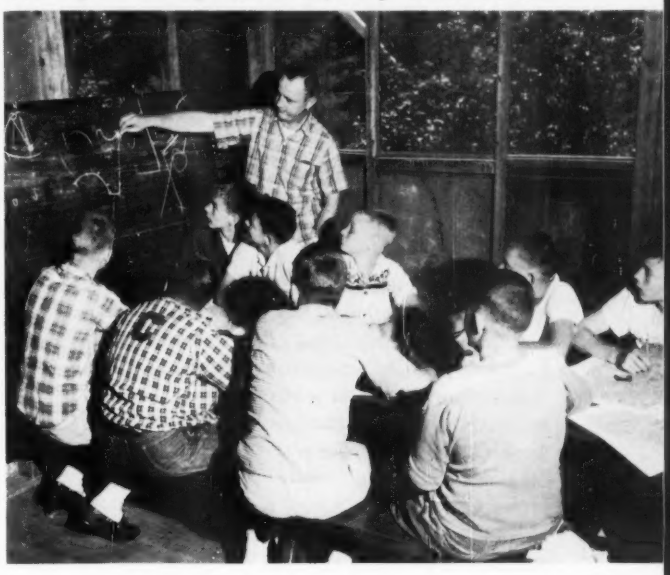
The school term was increased to two weeks after the first year and, so great is the demand for enrollment, it soon may be extended through the month of August.

Camp Jordan is ideally suited for such a project. The spacious main lodge includes an assembly hall with huge rock fireplace, office and store. Other buildings include a large dining hall and kitchen, infirmary, sleeping cabins for students and instructors, housekeeping cabins for camp officials and the cooks, and two large lavatories with hot and cold running water. All water for the camp is piped from a large spring back in the woods. The place is electrically lighted.

Ideal, too, is the rugged natural setting of deep, unspoiled mixed forest sprawling away in all directions, unbroken for many miles. Mountains and towering hills rise blue and brooding in the distance, and blathering trout brooks hurry down to the deep, granite-jowled nine-mile lake. Other lakes and ponds lie back in the green hills. Everything seems much as it was in the beginning, fresh, clean and good.

Wildlife in the vast region includes whitetail deer in large numbers, black bear, moose, ruffed grouse, the

The proper use of map and compass is an important study at the Junior Conservation School. The group below is receiving a "briefing" before departing for the woods.



Part of a class in Nature and Conservation is seated about a simple arrangement of tables and log seats in the "specimen area" in the woods by the lake, where plants and animals are displayed, studied and explained.

varying hare, bobcat, mink, beaver, red fox, muskrat, raccoon, otter, weasel, squirrel, woodcock, ducks, loons, hawks and various other species in fur and feathers, down to the song birds and mice.

The lake is populated with lake and brown trout of considerable size, as well as landlocked salmon, smallmouth bass, and several species of rough fishes.

There are periods for relaxation and play for the students following the noon and evening meals, but all other time—every crowded second of it—from a 7:30 breakfast to 5 p.m., is devoted to a strict and strenuous schedule. The evening program in the main lodge includes illustrated lectures and educational movies. All lights are out at nine o'clock.

The students are called from class to class by the wailing blast of a siren at the main lodge, and the counselors, University of Maine seniors, see to it that the various groups get there without delay and pay strict attention. Notes are taken at all classes, and examinations are held at the close of each week. Substantial prizes are awarded to those getting the highest rank.

Knowing well from experience that most of the new arrivals at the school regard the study of Nature as something strictly for girls and "sissies," I am successful to a surprising degree in deflating that common opinion when I address the entire student body in assembly the night before the week's classes get under way.

I point out strongly that the Maine Sportsmen's Junior Conservation School is based on the study of Nature, and on the conservation of all our priceless natural resources. They are then told that Nature is the oldest and soundest government on earth, and has operated successfully under but one law down through the centuries. They also are informed that our way of life—our very existence—depends upon it; that knowledge of Nature is vital and that its study is only for the persistent and intelligent.

In conclusion, I assure the new arrivals that if they are of the opinion that the study of Nature is a matter of making daisy-chains and gamboling through the fields in pursuit of butterflies, they have a startling surprise coming; that they will find that Nature is a real blood-and-thunder proposition.

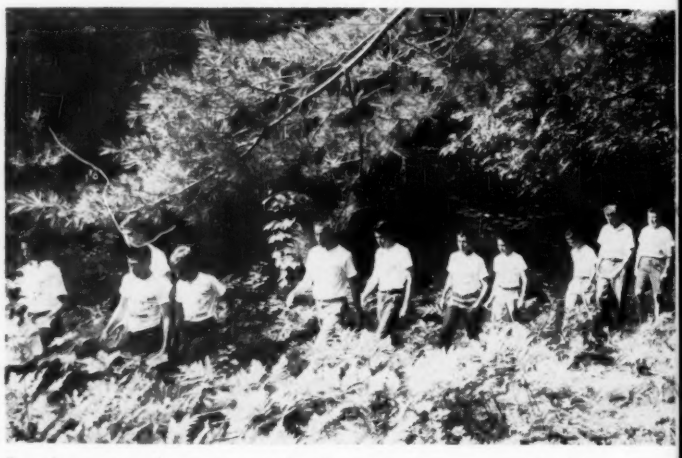
When I have finished my talk the hall is fiercely silent. The proverbial pin dropped on the floor would sound as though it were a crowbar.

My classes, one every two hours in swift succession throughout every day, open in what I call the specimen area. It is a simple arrangement of long tables and log seats in the woods by the lake, where various plant and animal specimens are displayed, studied and explained. I find here that my rapid-fire illustrations on two large blackboards leaned against the trees help greatly in holding the attention and deepening the interest of the students.

Classes also include Nature walks through the perpetual twilight of the great forests, and canoe trips along the lake shore and on placid streams twisting out from the bogs. The latter serve as part of the canoe-handling classes.

The "relativeness" of all things is carefully explained; the plant life, fishes, birds, mammals, reptiles, amphibians, insects, the wind, the rains and the snows. Plants, including the trees, are identified and studied. And, quite frequently, wildlife cooperates in the project by coming and remaining within study range. Occasionally, from the shelter of canoes beached and overturned, and well-thatched bough leantos, we watch and study the brewing and breaking of thunderstorms, their cause and effect and purpose. Nothing in Nature is left untouched.

One of the studies that interests the students most is how the forest mold, with its millions of tiny roots,



Supplementing the studies at the "specimen area" near the lake are nature walks in the perpetual twilight of the forests, and canoe trips along the lake shore and on the bog streams.

stores up part of the rainfall to prevent flash floods, erosion and the subsequent destruction of insect, plant and fish life. We probe into this phenomenon at every opportunity, proving that it is wrong to denude the banks of such streams.

Another study deals with natural propagation and predation that provide for sufficient populations of all species and controls to insure adequate supplies of the various foods in the interest of sound balance.

The study of fishes, and their foods and development, never fails to cause wide-eyed interest. The brooks, with their populations of trout and other species, enable us to study the fry as they feed on plankton and other microscopic animals in the nursery areas, and the fingerlings and adults as they seek and consume larger foods, including the aquatic insects in the larval and adult stages.

By the time this point in the course is reached the students are completely convinced that the study of

Nature is not strictly "for the girls and the sissies." They are wide-eyed, mystified, intensely interested boys in a new and wonderful world set apart. Slowly and carefully, deeper and deeper, the good seed is being planted in fertile soil.

Animal tracks in the soft places are studied and followed, and all sounds and smells of the deep woods are identified. The extremely important roles of those sanitary workers, the scavengers—birds, mammals, fishes—also are explained to destroy the all-too-common belief that the crow, raven, bear, snapping turtle, sucker, and cusk should be exterminated.

This part of the study takes up the identification, foods, and purpose of the carnivorous, herbivorous, and omnivorous animals. Bounties are explained and condemned, as is the cruel and needless slaughter of wildlife. It is pointed out also that, contrary to common belief, wildlife is not a crop that must be harvested; that, if and when any harvesting is needed, Nature in her infinite wisdom will do it expertly and mercifully, without the assistance of meddling and bungling Man.

Visitors at the school include many tourists and the heads of various conservation organizations in other States. They are able to attend my classes only at the specimen area near the main camp. It is encouraging, indeed, to hear their enthusiastic approval expressed and to find the names of their sons on the enrollment list for the following year. The students now come from all parts of New England and from places as far away as Pennsylvania.

One of the most interesting and enthusiastic guests ever to visit the school in the woods was my friend Maurice Sullivan, Government naturalist formerly stationed at Acadia National Park, near Bar Harbor, and now stationed in Washington, D. C.

Mr. Sullivan was my class guest, and after talking to the students of Nature and its importance, and the great value of the school, he gave an interesting demonstration in fire-building without matches His tools were the bow, spindle, friction block and tinder, all quickly collected there in the woods. Maurice had a fire going in less than fifteen seconds, to the delight of the students.

All other instructors are requested by committee chairman Victor Viola and other school officials to make frequent mention of conservation, and to recommend strongly the importance of Nature study.

It is indeed encouraging to learn that the study of Nature and conservation, questioned at first, soon becomes by far the most popular with the youngsters This opinion also is shared by the counselors.

This fact is revealed each year by printed forms on which the students check their favorite subjects, give their reasons, and add remarks. To encourage free expression, they are not required to sign their names. Of the 1500 students graduated from the school in nine years, less than a dozen indicated that Nature and conservation study did not interest them particularly. Only four said they did not like it at all.

Letters to me from the boys and many pleased parents, long after the school sessions have ended, are further proof of appreciation of Nature and an interest in its preservation, and that this unique institution is successful in its purpose.

Conservation officials from the State House in Augusta come by plane to visit the school each year. They remind the young students of the great and growing need for deeper understanding of Nature and the methods for its perpetual preservation. Education, they point out, is the only torch that can successfully dispel the gloom of destructive ignorance. The boys are reminded that one day in the future, as voters—perhaps as legislators or even governors—it will be their duty to protect their great heritage.

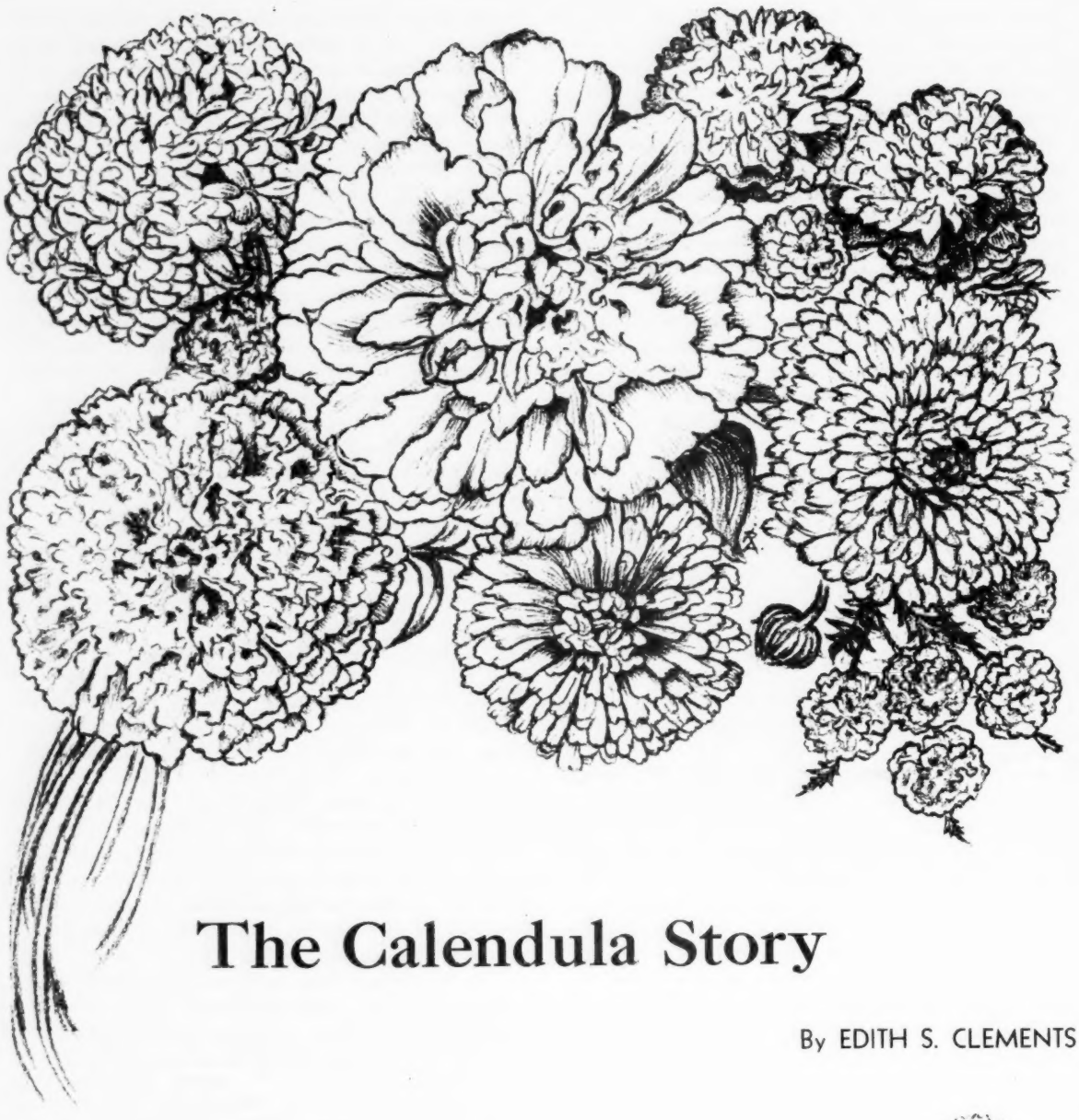
It costs much money to operate this school, more than a thousand dollars a week for food alone. The treasury never shows a surplus at such low tuition rates, nor does it ever "break even." There is no complaint, however, and the Penobscot Conservation Association gladly dips into its own treasury for three or four hundred dollars every year to clean up all bills.

The payless instructors just as gladly give up vacations and take time from their families and regular jobs, realizing that the planting of this good seed is one thing that can not be figured in dollars and cents.

SAFE

What brilliant or endearing specimen
Of other-planet ornithology
Could ever alienate me from the wren,
Or sing the matins of the thrush for me?
What creature-world of any neighbor star
Could lull me to forgetfulness that here
The kittens, silken and enchanting, are—
The fleet earth-horses, and the sloe-eyed deer?
What elegance of tree or flower-face
Could turn me from the pine against the sky,
The paper birch, wild rose, or trillium's grace?
Yet, under some fantastic spell, should I
Forsake my earth-loves, my terrestrial
Roots run too deep for soils celestial.

Elaine V. Emans



The Calendula Story

By EDITH S. CLEMENTS

CALENDULAS are among the aristocrats of the plant kingdom. Their descent may be traced through millions of years, back to the humble buttercup; yet today these plants stand on the highest pinnacle of specialization. They are not exclusive because of their high rank, since they belong to the composites—a group that is widespread in the world today, with many related families and hundreds of species. For sheer numbers, calendulas could be termed "common," but because of their high degree of structure, individually, they have become patrician. The flowers live in exclusive "communities" in which there is division of labor as well as cooperation, similar to that found in human communities.

Illustrations by Irene Gibian

Under the skillful hands of the plant specialists the blossom of the marigold, primitive form of the calendula (shown at the right), has evolved into forms like the brilliant, colorful flowers pictured above.

In the plant kingdom such "communities" are called "heads." Flowers of thistles, sunflowers and dandelions are examples. Each floret in each flower-head has a specialized task and often a different form, adapted to the better doing of this task. The florets may be all alike and simply fashioned, as in the thistles, or all alike and ribbonlike as in dandelions. In this type of "head," each floret makes a single seed, and the whole community attracts, by size and color, the insects so necessary to pollination. With other types of heads, the outer row of florets attract by greatly enlarging and flattening their corollas into the "ray flowers" of plants like sunflowers, asters and daisies. These are often mistaken for petals of a single flower, and it requires close attention to discover the difference.

Such doubling occurs in Nature only now and then. A doubled calendula is recorded in a herbal of the 16th century, and is described as "the greatest double marigold—at least three inches in diameter." Today, there is almost no limit to the number and size of double flowers produced under cultivation by the skill of the florist. The improvement of the dahlia and chrysanthemum has gone so far that it is almost impossible to realize that the marvelous blossoms of the flower-show were once "single" heads like those of the sunflower and daisy.

The Latin name of a flower classifies it as belonging to a definite genus of a family, and species of a genus. Common names usually lack indications of relationship. What we usually know as "marigold" may be "French marigold" or "African marigold," although both are natives of Mexico, and belong to the genus *Tagetes*. The fig marigold, *Mesembryanthemum*, is a member of the noonflower family. Calendula becomes "pot marigold," from its use in soups and savories, and belongs to a family of composites. Its Latin name refers to "calends," as the first day of the month in the Roman calendar.

In addition to the use of calendula as a savory herb, there was a recipe, in the year 1600, for the making of a concoction claimed to improve human eyesight to such an extent that one might even see fairies and spirits:

"We have a pretious unguent, prepared according to the recipe of a famous alchymist, which, applied to your visual orb, will enable you to behold without difficulty or danger the most potent fairy or spirit you may encounter. This is the form of the preparation: A pint of sallet-oyle, and put it into a vial-glasse, but first wash it with rose-water and marygolde water; the flowers to be gathered towards the East. Wash it until the oyle becomes white; then put it into the glasse, and then thereto the budds of hollyhocke, the flowers of marygolde, the flowers or toppes of wild thime; the buds of young hazle, and the thime must be gathered neare the side of a hill where fayries use to be; and take the grasse of a fayrie throne; then all these put into the glasse; and sette it to dissolve three days in the sunne, and then keep it for thy use."

There are few uses for calendula today in the culinary department. But a recipe for custard advises the use of crushed flowers as a flavoring, while there is a more complicated recipe for a cordial. A similar fate has overtaken calendula in the realm of medicine, where healing has become a science and not a blind fumbling among superstitions. However, since mind often triumphs over matter, it is quite possible that the concoctions formerly made from puppy-dog's tails, lizard tongues, and herbs "gathered by the light of the moon" were as effective as some of the nostrums of today, which depend more on faith than on their ingredients for cures.

Thousands of plant species have been tested for the presence of drugs and, sooner or later, many were discarded as of no value. Calendula, however, seems to have survived to some extent, since it is listed in the pharmacopeia of 1880 as an official remedy in both eclectic and homeopathic medicines. Its drug was originally used as a stimulant, or as a remedy for convulsions, typhoid, jaundice, or scrofula and the like. In the case of cancer, it was admitted that there was "no marked result, from either the internal or external use." By 1905, this drug was recommended only for its cooling and soothing properties as a tincture for sprains and bruises, and as an ointment for cuts, burns and poison ivy. Modern remedies have replaced it for these purposes,

Irked by the quarrels of love-smitten wood-nymphs, Diana, sister of the sun-god Apollo, changed the nymphs into calendulas, whose faces still constantly follow the sun.

Calendula was one of the ingredients of a formula for an unguent, "prepared according to the recipe of a famous alchymist," that, according to its makers, enabled the user to view the most potent fairy or spirit without danger.

but it still remains as an established contribution to the making of a yellow dye, or as an adulterant to the true saffron dye.

A Greek legend associates the feeling of jealousy with the yellow color of calendulas, and also explains why these flowers always turn their faces to the sun. It seems that some charming wood-nymphs were in love with Apollo, the sun-god, and their jealous quarrels angered his sister, Diana, to such a degree that she changed them into calendulas. This put an end to the quarrels and the jealousy, but love of the maidens for Apollo persisted in spite of this transformation into blossoms. This is attested by the fact that calendulas always turn their faces towards the sun.

In later times, when Christian beliefs had replaced the worship of gods and goddesses, "gold flowers" were associated with the name of the Virgin, and were called "Mary-goldes"—later "marigolds." Thus, calendulas were used in celebrating the Feast of the Annunciation, and a portrait of the Virgin, painted in 1430, depicts her as wearing a white robe ornamented with these blossoms. The Buddhists of India claimed marigolds to be sacred to one of their own goddesses, and, accordingly, calendulas were woven into garlands during sacred festivals. These were more or less joyous occasions, reflecting the sun-like character of the blossoms, but in Mexico, where they are orange-red in color, they are believed to have sprung from earth drenched with the blood of Aztecs slain by the Spaniards in search of land and gold in the New World. Here, then, calendulas became "Flowers of Death," and are used only in ceremonies dedicated to memories of the dead.

Flowers have ever been subjects of poetry and song. Although not noted for grace or delicacy, the sturdy blossoms of calendula have inspired poets, from Chaucer down through the years. In 1648, there was inscribed a quaint epitaph in the chancel of an English church in Devonshire. It refers to the flower as it turns its face to the sun:

"Dedicated to the pretious memorie of Mary ye deare and only daughter of George Westwood, Pastor of this Church and of Frances his wife; who, leaving this vale of miserie for a Mansion in Felicitie, we heer entered—January 31, Anno Domine 1648, Aetat suae 7.

This Mary-gold lo! hear doth show
Marie worth gold lies hear below!
Out doune by death, ye fair'st-gilt flour
Flourish and fade doth in an hour.
The Mary-gold in sunshine spread
When cloudie, clos'd doth bow the head.
This orient plant retains its guise
With splendent Sol to set and rise—
Ev'n so this Virgin Marie Rose,
In life soon nipt, in death fresh grows."

Shakespeare's writings contain so many references to flowers that entire books have been written about them. The marigold is the subject of some of the most charming verses. In *Cymbeline*, "winking Mary-buds begin To ope their golden eyes." In *The Winter's Tale*, amid much talk of garden flowers, Perdita, the daughter of the King and Queen of Sicily, offers a bouquet to the King of Bohemia, including "The marigold that goes to bed with the sun And with him rises weeping. . . ."

A contemporary of Shakespeare, George Withers, muses at considerable length on the charms of calendula and its constancy to the sun-god, in this fanciful stanza:

"When with serious musing I behold
The grateful and obsequious marigold
How duly every morning she displays
Her open breast when Phoebus spreads his rays;
How she observes him in his daily walk,
Still bending towards him, her small slender stalk,
How, when he down declines, she droops and mourns,
Bedewed as 'twere, with tears till he returns;
And how she veils her flowers when he is gone:
When this I meditate, methinks the flowers
Have spirits far more generous than ours."

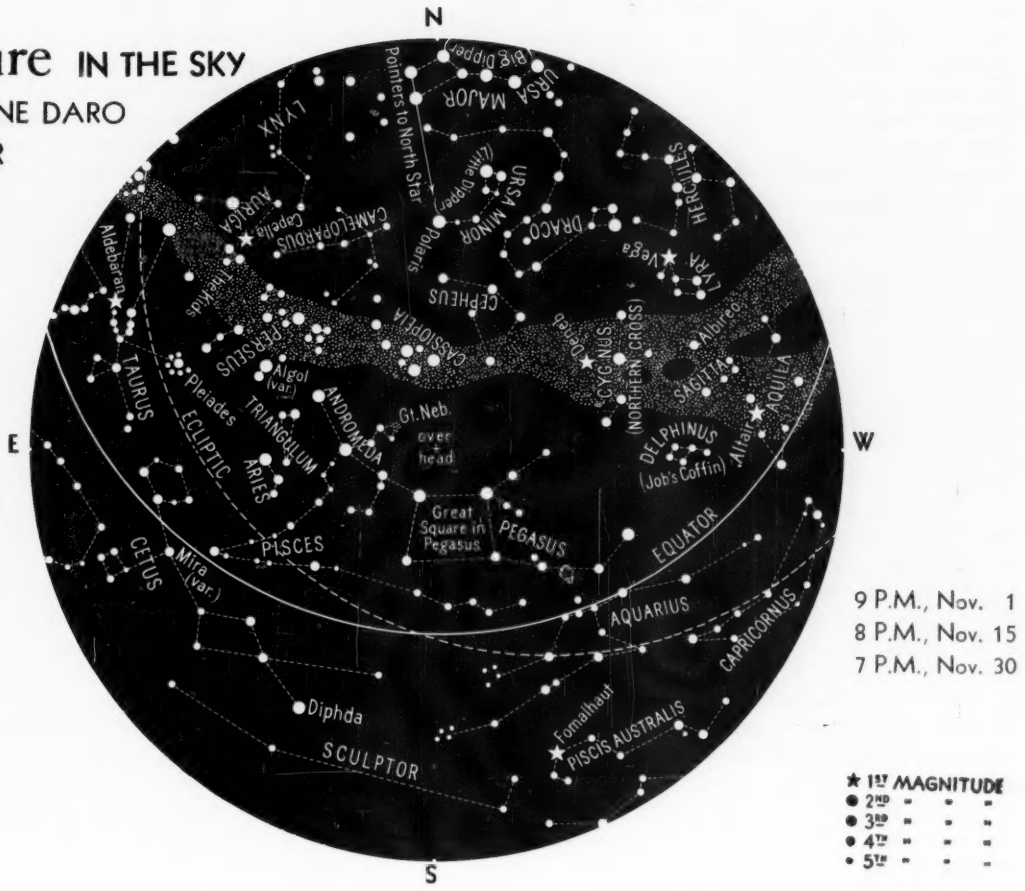
Keats joins the chorus of praise in the poem *I Stood Tiptoe Upon a Little Hill:*

"Open afresh your round of starry folds
Ye ardent marigolds!
Dry up the moisture from your golden lids,
For great Apollo bids
That in these days your praises should be sung
On many harps, which he has lately strung;
And when again your dewiness he kisses,
Tell him I have you in my world of blisses:
So haply when I rove in some far vale,
His mighty voice may come upon the gale."

(*Continued on page 500*)

Nature IN THE SKY

By SIMONE DARO GOSSNER



To use this map hold it before you in a vertical position and turn it until the direction of the compass that you wish to face is at the bottom. Then, below the center of the map, which is the point overhead, will be seen the constellations visible in that part of the heavens. Times given are for Local Standard Time.

The Origin of Life

QUIETLY and without benefit of headlines, considerable progress has been achieved in the past few years toward a better understanding of the manner in which living organisms were formed on the surface of the earth. This is an extremely complex scientific problem, because it overlaps the fields of chemistry, physics, biology, astronomy, oceanography, and geology.

Until the middle of the nineteenth century, the theory of spontaneous generation was the most generally accepted. For example, it was a popular belief that mice were literally created in filth (now we know that they are merely attracted by it). Similarly, scientific theories held that germs were formed spontaneously in various media such as stagnant water or a leftover bowl of soup. This notion of spontaneous generation was completely refuted in 1862 by the experiments of the French bacteriologist Louis Pasteur, for whom the process of pasteurization was named. Pasteur showed conclusively that if water—or soup, if you prefer—is fully sterilized and vacuum-sealed in an airtight container, no germs will appear, even after a considerable time.

For the next few decades, it was assumed that life is an inherent property of a certain category of matter, which makes it entirely distinct from other chemical compounds. Life, in this sense, could be defined as a capability for duplication and perpetuation, as found not only in the higher orders of plants and animals, but in the most elementary living cell as well. Thus an amoeba is alive, but an elaborate chemical molecule is

not. Scientists, circa 1910, firmly believed that there was no bridging that gap. As a consequence, the appearance of life on earth was explained by the insemination theory, in which it was proposed that primitive living organisms had been brought from outer space to an originally sterile earth by meteorites and interstellar dust. It is worth noting that the proponents of the insemination theory showed a remarkable lack of concern for the manner in which life began elsewhere in the first place.

The contemporary views on the subject began to evolve in the nineteen-twenties. Independently of each other, J. B. S. Haldane, in England, and A. I. Oparin, in Russia, attacked the problem from a radically new angle. Until then, scientists had vainly attempted to trace the evolution of complex molecules into living cells under terrestrial conditions *existing at the present time*. Haldane and Oparin, on the contrary, began to consider the kind of physical and chemical conditions that were present *when the earth was very young*.

WARY ORB

The moon presents a smiling face,
Yet doesn't trust the earth, I fear. . .
Or not enough, in any case,
To turn her back upon this sphere.

Georgie Starbuck Galbraith

These primitive conditions are relatively well-known from the accumulated evidence furnished by the observation of other planets and from theories concerning the origin of the solar system. The earth was mostly covered by oceans. Above them hung a primitive atmosphere composed principally of methane, ammonia gas, water vapor, hydrogen, and perhaps carbon dioxide. Electric discharges, in the form of lightning, are thought to have been frequent.

Free oxygen was not present in this primitive atmosphere. It appeared later, principally as a result of plant breathing. If there was no oxygen, there could be no ozone, since the ozone molecule is made up of three atoms of oxygen. Without ozone, the ultraviolet rays of the sun are not screened out and reach the earth in full force. Haldane, in 1928, called attention to the fact that organic compounds had been obtained in the laboratory by submitting a mixture of water, carbon dioxide and ammonia to a heavy dose of ultraviolet rays. Among the substances thus obtained were some materials that are found in proteins, one of the most important constituents of living matter. Thus, conceivably, the basic substances from which live cells could evolve were formed in the primitive ocean under the effect of the sun's ultraviolet rays. Subsequent laboratory experiments have shown, however, that this process could account only for a small percentage of the organic compounds formed in the primitive oceans.

Oparin's theories, on the other hand, were published in 1936 (after a preliminary essay in 1923). They are too complex, unfortunately, to be summarized in a few lines, but suffice it to say that they furnished the inspiration for one of the most fundamental experiments performed in this field. In 1955, Stanley Miller, of the University of Chicago, submitted a mixture of water, ammonia gas, methane and hydrogen, simulating the primitive atmosphere, to a series of weak electrical discharges for a period of about a week. The analysis of the mixture at the end of this period revealed the presence of substantial amounts of amino-acids and other compounds, which are essential constituents of proteins and nucleic acids.

The Stanley Miller experiments were duplicated and verified in other countries, notably England. Abelson, at the Smithsonian Institution, repeated them while modifying the contents of the original mixture. He obtained substantially the same results, thus proving that the exact contents of the primitive atmosphere need not be known accurately (as they cannot be) to pursue the subject.

What has been accomplished in all this, and what remains to be done? We know now that under the conditions in existence when the earth was young, the basic substances contained in a living cell could be formed from simple, non-organic molecules. This is the first step in the long evolution toward living matter. Isolated proteins and nucleic acids, however, are incapable of reproduction or duplication; they are not alive. We do not know yet how they combine to form a live cell, nor do we know at what stage in their development the perpetuating or duplicating process begins.

The ultimate goal in our understanding of the origin of life is the synthesis of a living cell in the laboratory. This cannot be done yet, but biochemists have a clear understanding of the intermediate steps that will eventually lead them to this crowning achievement. They may even be assisted in their endeavor, if interplanetary explorations become a reality. It is not at all impossible that some early stage of life's development might be encountered on one of the other members of the solar system.

In the month of November, the moon will be full on November 15, and the New Moon will occur on November 30.

Mercury will be an evening star until November 24. On November 3, it will be at its greatest eastern elongation, but will be rather poorly placed for observation. It will be located low in the southwest after sunset, and will set one hour after the sun on November 1, one-half hour after the sun on November 15. On November 24 it will be in inferior conjunction with the sun, and will enter the morning sky.

Venus, in Virgo, will be at its greatest western elongation on November 11. A very brilliant and conspicuous morning star, it will rise nearly four hours before the sun during the whole month of November, and will be high in the southeastern sky at dawn. Its magnitude will decrease slightly from —4.1 (*Continued on next page*)

on November 1 to −3.9 on November 30.

Mars, in Libra, will still be too close to the sun for observation. Even by November 30, it will rise only 45 minutes before the sun.

Jupiter, in Scorpius, will be low in the southwest at sunset, setting one and one-half hours after the sun on November 1, one-half hour on November 15. It can not be observed after the first week of November, because of its proximity to the sun. Its magnitude on November 1 will be −1.3.

Saturn, in Sagittarius (magnitude +0.8), will be low in the southwestern sky at dark, setting at about 8 p.m. on November 1, 7:30 p.m. on November 15, 6:30 p.m. on November 30.

The Taurid meteor shower, which extends from October 26 to November 16, will reach its maximum on November 6. On that date, the Taurids may attain a maximum zenith rate of 15 meteors per hour.

Observations of the Leonid meteors on November 15 to 17 will be greatly hampered by the full moon.

Outdoor Laboratories

In an introductory paragraph to "Manual for Outdoor Laboratories," recent publication of the National Association of Biology Teachers, Dr. Richard L. Weaver, associate professor of conservation and conservation education at the University of Michigan, and editor of the manual says: "School grounds are becoming increasingly valuable and recognized as important outdoor laboratories for school programs of study in science, agriculture, mathematics, and other subjects."

The mechanics for establishing such outdoor laboratories, with examples from laboratories that have already been established, are set forth in this illustrated 7-1/8" x 10" sized manual, priced at $1.25 and available from the Interstate Printers and Publishers, Inc., 19-29 No. Jackson Street, Danville, Illinois. What features to emphasize, the different uses that can be made of such areas and practical suggestions for features like gardens, weather stations and picnic grounds are included in the various articles that comprise the manual.

Sea Otter Film

The western Aleutian Islands of Alaska are the locale for a 16-mm. color and sound film entitled "The Sea Otters of Amchitka," said to contain the most comprehensive footage on sea otters available anywhere. The film, obtainable from Thorne Films, Inc., 1707 Hillside Road, Boulder, Colorado, is suitable for conservation, ecology and animal behavior classes at college and junior college levels and to general adult and high school student groups. The sea otter, once virtually exterminated, has made a comeback in parts of Alaska, and occasionally may be seen in Pacific coastal waters.

Bulletins

"Experiments Using the 3-D Microscope," by Julian D. Corrington, professor of zoology at the University of Miami, is a publication of the Bausch and Lomb Optical Company, of Rochester 2, New York. In this 12-page booklet Dr. Corrington, well-known to readers of *Nature Magazine* as author of the monthly feature *Nature and the Microscope*, describes some of the advantages of the three-dimensional microscope in experimental work, and takes readers through a number of 3-D microscopical experiments in the zoological field that can be performed with a minimum of preparation and training. Available from the publisher without charge.

"The Dutch Elm Disease and its Control" is Agriculture Information Bulletin 193 of the U. S. Department of Agriculture. This is a 14-page discussion of the Dutch elm disease caused by the fungus *Ceratocystis ulmi*, the most destructive shade-tree disease in the United States at the present time. The history, symptoms, and treatment of the disease are told, and a map of the distribution of the disease and its principal carrier, the elm bark beetle, is included. Ten cents, from the Superintendent of Documents, Washington 25, D. C.

"Poisonous Grassland Plants" and "Introduced Grasses and Legumes," sections 4 and 5 of a series entitled "Pasture and Range Plants," are published by and are available from the Phillips Petroleum Company, Bartlesville, Oklahoma. These large-format brochures, dealing with the subjects named in their titles, are handsomely printed and are illustrated in full color, and should make welcome additions not only to the libraries of cattle and sheep raisers, for whom they are primarily intended, but also to those of amateur botanists.

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Nature IN THE SCHOOL

By E. LAURENCE PALMER

Professor Emeritus of Nature and Science Education, Cornell University, and Director of Nature Education, The American Nature Association

About Perch and Bass

WE HAVE ELECTED TO DEVOTE THE School Page of this issue of *Nature Magazine* to a consideration of the popular literature associated with the subject of our special educational insert.

It is quite possible that, like the writer, some boy may quicken his interest in biology by now and then finding in the library a book that touches on his particular interest, at least to some degree. From a rich library on fishes, we suggest the consideration of the following books that touch on the taxonomy, economy, management and capture of some relatively common bass and perch. Check this list with the books in your library, and possibly enrich what you find by a few not now there.

Ackerman, Bill, *Handbook of the Fishes of the Atlantic Seaboard*. American Publishing Company, Washington, D. C. 1951. 144 pages.

Bates, Joseph D., *Spinning for American Game Fish*, Little Brown and Company, Boston. 1947. 247 pages.

Bergman, Ray, *With Fly, Plug and Bait*. William Morrow Company, New York. 1947. 640 pages.

Blaisdell, Harold F., *Tricks That Take Fish*. Henry Holt and Company, New York City. 1954. 299 pages.

Brooks, Joe, *Bass Bug Fishing*. A. S. Barnes and Company, New York City. 1947. 69 pages.

Salt Water Fly Fishing, G. P. Putnam's Sons, New York City. 1950. 200 pages.

————, *Complete Book of Fly Fishing*. Outdoor Life, New York City. 1958. 352 pages.

Caine, Lou S., *North American Freshwater Sport Fishing*. A. S. Barnes Company, New York City. 1949. 212 pages.

Carlander, Kenneth B., *Handbook of Fresh-water Biology*. William C. Brown Company, Dubuque, Iowa. 1950. 429 pages.

Dahne, Robert, *Saltwater Fishing*. Henry Holt, New York City. 1950. 342 pages.

Dalrymple, Byron, *Panfish*. Whittlesey House, New York City. 1947. 398 pages.

———— *Ice Fishing for Everybody*. Lantern Press, New York City. 1948. 257 pages.

Davis, H. S., *Culture and Diseases of Game Fishes*. University of California Press, Berkeley, California. 1953. 332 pages.

Davison, Verne E., *Homemade Fishing*. Stackpole Company, Harrisburg, Pennsylvania. 1953. 205 pages.

Eddy, Samuel, *How to Know the Fresh-water Fish*. William C. Brown, Dubuque, Iowa. 1957. 253 pages.

Eddy, Samuel and Surber, *Northern Fishes*. University of Minnesota Press, Minneapolis, Minnesota. 1943. 252 pages.

Eschmeyer, R. W., *Billy Bass*. Fisherman's Press, Oxford, Ohio. 1951. 478 pages.

————, *Bobby Bluegill*. Fisherman's Press. Oxford, Ohio. 1952. 47 pages.

Harlan, James and Everett B. Speaker, *Iowa Fish and Fishing*. Iowa State Conservation Commission, Des Moines, Iowa. 1951. 237 pages.

Hawes, Harry B., *My Friend, the Black Bass*. Frederick Stokes, New York City. 1930. 288 pages.

Henshall, James A., *Bass, Pike, Perch and Others*. Macmillan Company, New York City. 1903. 410 pages.

Hollis, Harold C., *Bass Tackle and Tactics*. A. S. Barnes Company, New York City. 1945. 147 pages.

Hubbs, Carl and Lagler, Karl F., *Fishes of the Great Lakes Region*. Cranbrook Institute Bulletin 26. Bloomfield Hills, Michigan. 1947. 186 pages.

Lagler, Karl C., *Freshwater Fishery Biology*. William C. Brown Company, Dubuque, Iowa. 1952. 471 pages.

La Monte, Francesca, *North American Game Fishes*. Doubleday and Company, New York City 1945. 202 pages.

————, *Marine Game Fishes of the World*. Doubleday and Company, New York City. 1952. 190 pages.

McClaine, A. J., *The Wise Fisherman's Encyclopedia*. W. H. Wise Company, New York City. 1952. 1336 pages.

————, *Spinning for Fresh and Salt-water Fish of North America*. Prentice Hall, New York. 1952. 280 pages.

Outdoor Life, *Outdoor Life Fishermen's Encyclopedia*. Outdoor Life, New York City. 1953. 252 pages.

Rodman, O. H. P., *Striped Bass*. A. S. Barnes Company, New York City. 1944. 56 pages.

————, *The Saltwater Fisherman's Favorite Four*. William Morrow Company, New York City. 1948. 192 pages.

Roundsell, George A. and Everhart, W. H., *Fishery Science, Its Methods and Applications*. John Wiley and Sons, New York City. 1953. 444 pages.

Sharp, Hal., *Sportsman's Digest of Fishing*. Sterling Publishing Company, New York City. 1953. 253 pages.

Shoemaker, Myron, *Freshwater Fishing*. Doubleday and Company, New York City. 1946. 218 pages.

Steel, Frank R., *Bait-casting with a Thermometer*. Grossett and Dunlap, New York City. 1947. 150 pages.

Zachy, Harry, *Let's Fish*. Alfred Knopf, New York City. 1952. 301 pages.

Bulletin

"The Story of the Gray Whale," by Dr. Raymond M. Gilmore, research curator of marine mammals at the San Diego Museum of Natural History, is a 16-page monograph depicting the life, habits and history of the California gray whale. Illustrated with photographs by the author and others, this publication may be obtained for fifty cents from either the Museum of Natural History or the Cabrillo Historical Association, Box 6175, San Diego 6, California.

Reviews

Campsite Finder

By Richard and Jane Hartesveldt. P.O. Box 46, San Martin, Cal. 1959. Naturegraph Co. 80 pages. $1.00.

This is a useful publication providing a quick and easy way of locating more than 1500 public camping sites on the Pacific Coast and Alaska.

Camping and Outdoor Fun

By Major Mauno A. Lindholm. New York. 1959. Hart Publishing Co. 192 pages. Illustrated by Justin Pearson. Paper bound, $1.50.

A practical guide to living and enjoying living in the outdoors, directed primarily to the needs of the younger outdoorsman.

Wild Folk at the Seashore

By Carroll Lane Fenton. New York. 1959. John Day Company. 128 pages. Illustrated by the author. $3.50.

Perhaps Nature is at her most changeable when she is found at the seashore. At least this is the conclusion in this book for the up-to-fourteen reader. It will answer many questions about seashore life, and will enrich the experience of a day or a summer where the ocean meets the land.

The Canvasback on a Prairie Marsh

By H. Albert Hochbaum. Harrisburg, Pa. 1949. The Stackpole Company. 207 pages. Illustrated. $4.50.

In 1938, Al Hochbaum, trained at Cornell and Wisconsin in wildlife management, went to Delta Waterfowl Research Station in Canada to study ducks. In 1944 a book reporting on these studies, and bearing the present title, was published by the American Wildlife Institute. Now comes a second edition, the Institute having in the interim changed its name to the Wildlife Management Institute, and the author, in the same interim, having learned new things. Because of publication costs the second edition is republished but the author has added appendices where new and different data have been developed.

Science You Can Use

By George K. Stone and Lucy W. Stephenson. Englewood Cliffs, N. J. 1959. Prentice-Hall, Inc. 383 pages. Illustrated by Robert Candy. $4.40.

This is a practical and colorful textbook designed to lead the upper elementary and junior high school student into appreciation and application of science. The authors start with the living things around us—mammals, reptiles, birds, fishes, insects, trees, etc. Succeeding chapters deal with the individual, electricity, gravity and motion, fire, light, air, the changing seasons, rocks and flowers and seeds. There are more than 1200 illustrations in color integrated with the text. A Teacher's Edition, which we have not seen, has expanded contents and teaching suggestions.

Goats

By Wilfred S. Bronson. New York. 1959. Harcourt, Brace and Co. Illustrated by the author. 64 pages. $2.95.

When Wilfrid Bronson tackles a subject in the field of Nature, whether for a young audience—as in this case—of for older folks, one can be sure that the result will be informative and entertaining. Add to this his always distinctive and expressive illustrations and one has a fine combination. We had no idea goats were so interesting.

Briefly Noted

Lewis and Clark. By Madge Haines and Leslie Morrill. New York. 1959. Abingdon Press. 128 pages. Illustrated by William Hutchinson. $1.75. Stirring story of these great explorers. Written for the 8 to 12 audience.

Animal Habits. By George F. Mason. New York. 1959. William Morrow and Co. 93 pages. Illustrated by the author. $2.50. Interesting stories about animal behavior and behaviorism for the young reader 10 to 14.

Succulent Plants. By A. Bertrand. New York. 1959. Philosophical Library. 120 pages. Illustrated in color and black and white. (Second edition). $6.00. New edition of this book with new illustrations.

Gargantua the Great. By James A. Ward. New York. 1959. William Morrow and Co. 127 pages. Illustrated by Seymour Fleishman. $2.95. The true story of this famous gorilla, raised as a pet and destined for circus billings as the most dangerous animal in the world.

Snow Surveyors. By C. B. Colby. New York. 1959. Coward-McCann. 48 pages. Illustrated. $2.00. Story of the men who "count the snowflakes" to learn of the supply of water that we may be prepared for flood or drought.

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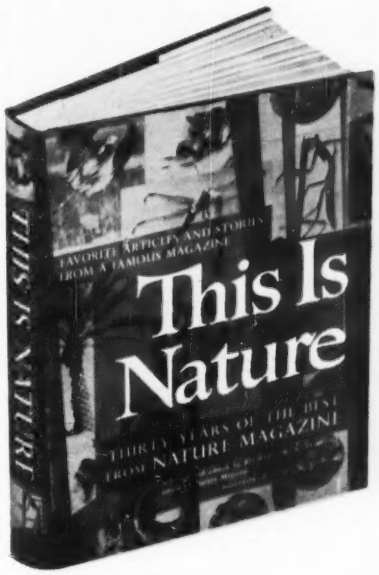
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THE Nature CAMERA

By EDNA HOFFMAN EVANS

Two events photo-wise

A GLANCE AT THE CALENDAR REMINDS us that it is high time to be thinking seriously about two important annual photographic events. The first is the approaching deadline for the 15th annual Chicago International Exhibition of Nature Photography. The second is the even sooner approaching deadline for preparing photographic Christmas cards.

To consider them individually, let us get the facts on the Exhibition first. Deadline for this is January 18, 1960. Entry forms may be obtained from Mr. Wendell Dahlberg, 1121 W. 93rd Street, Chicago 20, Illinois. The event, which is the largest photographic Nature show in the world, is again sponsored jointly by the Nature Camera Club of Chicago and the Chicago Natural History Museum.

Each individual photographer may enter four slides and/or four prints. Entry fee for each group of four is one dollar, plus return postage. It is an honor as well as a great credit to a photographer's skill to have a print or a slide accepted by the show —many more entries are received each year than are accepted—and it is a high honor, indeed, to receive any of the silver medals or ribbon awards. The accepted material will be on display at the Museum February 2-26, 1960.

This is an exhibition that I heartily endorse (and, ruefully, I must admit that the judges have rejected more of my entries than they have accepted). It is a boost and a challenge to Nature photographers all over the world. Also, I have never ceased to admire the motto of the Chicago club: "To make the naturalist a better photographer; to make the photographer a better naturalist."

Christmas cards

Now to proceed to the problem of photographic Christmas cards. Already there are holly and Santa decorations in the downtown stores, and reminders in the postoffice to "do your mailing early." If you need yuletide "props" you should have no difficulty in obtaining them. If you need incentive, just remember the long lines that will soon be forming in front of the stamp and package windows.

"Store bought" Christmas cards are beautiful, and they are fine to send people you do not know very well but wish to remember. But for the really "personal touch" in this annual card-mailing frenzy that we Americans go into, a photographic Christmas card is hard to equal.

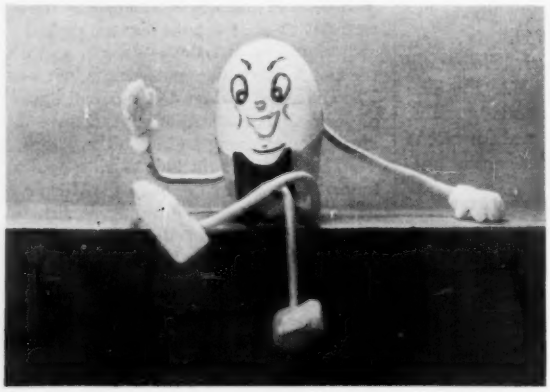
The easiest way to turn out such a card is to pick some negative from the year's accumulation and take it to a commercial photo shop. The clerk will be happy to show you a whole portfolio of stock masks with appropriate greetings on them. There are vertical and horizontal openings of various sizes into which your picture will fit. Make your choice, leave the negative with your order, and pick up your finished cards in a week or so. All that then must be done is to sign, address, and stamp them.

Cards like these, to my way of thinking, are nice—but dull. People usually pick a snapshot of their home, or the baby, or maybe the dog. Or, if they make a picture purposely for the card, it may be of the family group, posed self-consciously on the sofa. Such a card lets the receiver know how the house looks, or what is what with the family. But it is a "card for the record" only. It lacks impact for anyone but Grandma or Great-Aunt Matilda, who collect family pictures.

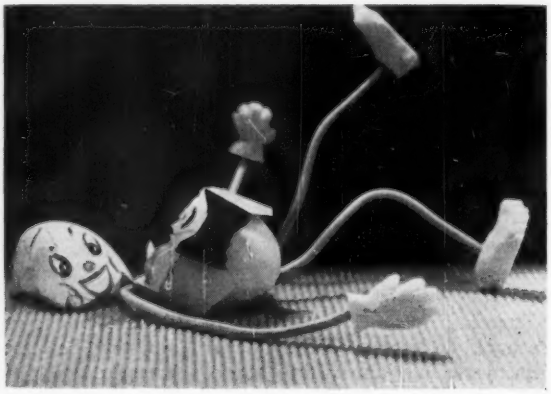
Cards with "zip"

If you have the time and energy to spend, you can produce a card that has a lot more "zip" to it. Pick out a theme and build your greeting around it. What are you trying to say? What, if anything, is new with you? Do you have any hobbies? Do you live in a region that has anything particularly different about it? By using a little thought, you can show the folks what you look like and at the same time give them a thumbnail sketch of what you are doing. You can include your greeting in the picture itself and use the whole card for the photograph. In this way, your picture will really "say more than a thousand words."

"Humpty Dumpty sat on a wall." Table-tops like these are fun to construct, and the various ingredients are not difficult to acquire.



"Humpty Dumpty had a great fall." Were I to do this one over again, I would change the expression on Humpty's face before breaking him.



This Christmas greeting was, I think, the most successful "western" I have dreamed up. The items of prospector's equipment were not hard to borrow, and the setting was not hard to find. To finish off the effect, I put a few specks of gold glitter in the pan on each card—and it looked as though I had really struck "pay dirt."

Cards of this sort usually must be self-printed, as well as self-inspired. If such facilities are beyond your reach, you will have to use whatever commercial resources are available.

Color photographers can buy special masks into which the printed color pictures may be inserted. These make very effective greetings, although they are also rather expensive. The expense comes in having the color prints made. For those who are skilled enough to make their own color prints, the problem is not so great.

Remember that it takes several weeks to get color prints made from a transparency or color negative. Most commercial photo shops will take your order and send it off for processing.

If you do not have such a service readily available, or if your wish to try something different, write to Wally Anderson, Color Photography, 330 E. Palace Avenue, Santa Fe, New Mexico, and ask for his specification sheet and price list.

While I, personally, always use the western theme with me and my dog in action (covered wagon, rope twirling, corral sitting, branding iron wielding, gold panning, and the like) I also have a fondness for table top cards. Some year, when I run out of western ideas (and after eleven years I am beginning to) I am going to try for a Christmas table top.

Table tops, to me, are the most interesting and entertaining kind of creative photography. I get a great deal of fun out of dreaming them up and—if it were not for having to put all the junk away again after I have dragged it out—I could really claim table tops as my favorite form of indoor photographic recreation.

Consider the two Humpty Dumpty shots. They are not exactly Christmasy in spirit, but they illustrate what a camera bug can do with a little imagination and a few simple props.

Humpty Dumpty, of course, is an egg. His cravat is of white and colored construction paper, held in place with Scotch tape. His arms and legs are insulated copper wires and his hands and feet were carved with a pocket knife from a piece of pink soap. His wall is a piece of cardboard with the rocks drawn in with heavy black pencil. The face, too, is drawn with appropriately colored pencils.

After I had taken enough pictures (I took some color shots as well as some black-and-whites) of Humpty sitting on the wall, I broke the egg and arranged him after his "great fall." One change I would make, were I to do it over, would be to erase the "smile" from his face and substitute a more appropriate expression in keeping with his comedown.

That is as far as I have been able to go with the old nursery rhyme.

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This picture illustrates the tremendous possibilities of flash photography. The tiny flashbulb, scarcely larger than a jelly-bean, will produce a flash of light greater than that produced by the giant 10-kilowatt light bulb shown in the illustration.

I have yet to figure out how to show, photo-wise, that "all the king's horses and all the king's men could not put Humpty Dumpty together again." Any suggestions or solutions?

I am always on the watch for items that can be used in table tops and miniature scenes. Toy shops, novelty departments, and the ten-cent-store are my favorite hunting grounds. Not only do they supply the materials, but they are also good sources for more table top ideas.

Table top ideas

There are some good table top suggestions in the Eastman booklet "Adventures in Indoor Color Slides" (50c), as well as in books and handbooks devoted exclusively to table top photography. Also, there is good how-to-do-it information in the little pamphlet "Miniature Worlds On A Table Top" (10c), available from Revell, Inc., 4223 Glencoe Avenue, Venice, California. It tells what to use in table tops to simulate things like ground, snow, lakes, oceans, ice caps, and the like.

Specifically on the subject of Christmas cards is another Eastman Kodak publication, "Photographic Greetings Cards" (25c), which is available from most photo dealers as the holiday season approaches.

People who are intrigued by statistics may find the following figures interesting. According to a report from the Westinghouse photo lamp marketing division, amateur photographers this year will use more than a third of all the photographic supplies sold in this country. By the end of the year shutterbugs will have taken more than two billion pictures. For supplies to keep them shooting, they will spend better than two billion dollars, which is an increase of nearly eight percent over the amount spent last year. Amateur photographers spend more than forty percent of the total, and their purchases will contine to increase in the years to come, according to Westinghouse predictions.

It is hard to believe that the popularity of amateur photography is so recent, but it is only within the last few years that easily usable materials have been available to the ordinary non-professional camera fan. It was not until 1930 that even the professional photographer was able to shift from flash powder or magnesium ribbon to the much safer and more dependable flash bulb. Before that, flash photography was a hazardous business, and many a photographer or his subject was badly singed in the process.

Enormous demand

Since 1930, when only 2,063,000 of the newly developed flash bulbs were sold, the market has increased tremendously. With approximately 26 million cameras in the United States now equipped to take flash pictures, the total sale of flash bulbs in 1958 was 556,636,000, and the total for 1959 is expected to reach 618,000,000. That—if you can possibly visualize them—is a lot of flash bulbs.

The development of amateur flash photography has had another effect on the photo business, according to Westinghouse statisticians. Formerly, film developers and printers were busy only during the summer, when pleasant weather made outdoor photography easy and comfortable. But now the use of flash bulbs for indoor pictures, and for auxiliary light when more is needed outdoors or for night shots, has transformed the business into a steady one the year round.

So it would seem that keeping the amateur photographer in shooting readiness has become big business—as well as a business that will get even bigger as the hobby continues to grow.

Weather Glass

We recall, as a boy, being fascinated by the activities of colored water in what looked like a half-pitcher with a long spout. It hung on the wall of an aunt's home on Cape Cod. We remember Aunt Betty remarking, after a look at the instrument, that "it looks like falling weather." Recently we came across one of these simple barometers called "The Ol' Nantucket Weather Glass," an attractive wall ornament, conversation piece and weather forecaster made by Doerr Glass Specialties of Vineland, New Jersey. According to the manufacturers, these weather glasses were used in the old square-rigged windjammers, although just how they retained their equilibrium and accuracy when the ship heeled over in the wind escapes us. Be that as it may, one of these barometers is now adorning our vestibule, endeavoring to cope with the prognostication of Washington, D. C. weather, thus far without notable success. However, this is a task that often has the scientific forecasters, with all their instruments and know-how, baffled.

Open Land Crisis

"The Crisis in Open Land" is a 30-page, dramatically illustrated booklet that we wish could be placed in the hands of every legislator, Federal and State, everyone active in civic affairs, everyone in a position to influence public opinion in any way. Prepared by the American Institute of Park Executives as a result of a workshop on Park Education, this publication presents concisely the crisis that exists as urban sprawl takes over, usually without concern for preservation of open space. National Parks and National Forests, State and local parks, and similar reservations will be nowhere nearly adequate to meet the demands of an outdoor-going and increasing population. As this publication states: "Action to meet the open land crises in our metropolitan communities must start at the earliest possible moment and move fast. Tomorrow will be too late." In many cases it is already tomorrow and, thus, too late. This need not everywhere be the case. Copies of this important booklet are available at fifty cents (possibly less in quantity) from the American Institute of Park Executives, Ogelbay Park, Wheeling, West Virginia.

Nature IN ROCK AND MINERAL

By PAUL MASON TILDEN

Rocks, Blades, & Pawnshops

AMONG THE MANY ROCK TYPES that men have been able to turn to their advantage there are several whose past histories have never been wholly unraveled by the geologists. For example, there is the soft, red clay-like stone that has been quarried for several centuries by our American Plains Indians "at the place of the red pipestone"—now preserved for the use of all American Indians in a national monument near the city of Pipestone, Minnesota—for ceremonial pipe material. Exactly how this thin seam of catlinite (as it is called, after the traveler-painter George Catlin) happened to be emplaced within a matrix of massive Sioux quartzite is still a matter for speculation.

Another rock type whose past is not clearly understood is the *novaculite* of the ancient Ouachita (or Washita) Mountains of Arkansas and Oklahoma, which is extensively quarried in the vicinity of Hot Springs, Arkansas. This is the rock that, after being fabricated into smooth slabs of various sizes, becomes the world-famous "Arkansas oilstone," used for honing cutting edges like engravers' and carpenters' tools, precision cutting instruments of all kinds—surgeons' knives, for example—and for pointing hypodermic and other needles.

Differing opinions

A quick winnowing of available literature reveals little but a diversity of opinion regarding the geological antecedents of this strange rock type. Webster's dictionary notes that the word "novaculite" stems from the Latin *novacula*, a sharp knife or razor, and adds that novaculite is a siliceous rock thought to be of sedimentary origin. There are many rock types, however, that answer to this general description.

One authoritative text on geology volunteers the fact that novaculite is a gritty, porcelaneous rock that, besides being siliceous, is sometimes porous—and lets the matter drop at that point.

Another text, equally authoritative, takes the horns of the "critter" boldly in hand, and says that this silica-rich rock is a "radiolarian chert," metamorphosed by folding. A third volume finds that the silica that composes almost a hundred percent of the body of pure novaculite was derived from the submarine alteration of volcanic ash. James D. Dana, one of the earlier great names in American geology, was of the opinion that novaculite was an exceptionally fine-grained sandstone. About the only point of agreement that can be found is that the rock seems, indeed, to have had a sedimentary origin!

Under the microscope, thin sections of novaculite reveal a jumble of quartz grains, closely fit together, with little or no pore space between them. In the words of one investigator, the quartz grains "are not cemented, but seem merely to be jammed together, the tenacity of the stone apparently being due to the interlocking of the edges of the grains."

Aside from its commercial aspects and its cloudy past, novaculite is a most handsome rock. Some is a beautiful ice-blue, like the ice that forms under the winter snowdrifts of our northern States. There are rose-colored, orange, gray, and rose-and white banded varieties—the last named of which is known to the trade as "rainbow"—and a dead-black kind that is called "blueberry." A specimen of novaculite, held in the hand and struck sharply with a hard object, rings like a fine cut-glass bowl.

More local names

Mr. Frank Phillips, of the Arkansas Oilstone Company, of Hot Springs, one of the firms that mines and produces the "hard Arkansas oilstone," recently furnished *Nature in Rock and Mineral* with several samples of novaculite, among which was a "mine-run" piece that was pale gray, with a black center, locally known as "blackheart." Another specimen exhibited what the quarrymen, simply but descriptively, call a "sore"—a dark inclusion surrounded by a halo of buff-colored stain. Such "sores" or other imperfections, of course, disqualify a slab for commercial purposes, and the waste in hewing out and cutting the stone to desired shapes is tremendous.

A small amount of the "blueberry" variety of novaculite, which is otherwise commercially worthless, is fabricated for a special and most unusual purpose. It finds a place in the pawnshops of Europe, where, if a customer goes in with "gold" to pawn, the proprietor will merely rub a sample of it across a piece of black novaculite and test the resulting smear with acid. . .just to make sure it *is* gold! Black novaculite, appropriately enough, also is known as "gold touch stone."

Since there is a large abundance of black novaculite, it was natural that quarrymen should have tried to find some larger commercial market for it—in the manufacture of table-tops, for example, as the stone takes a remarkably fine polish. Unfortunately, the stone developed conchoidal cracks wherever very hot dishes were placed, so that black novaculite still finds little use beyond the small amount needed by Europe's pawnbrokers.

(Continued on following page)

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It might be pointed out that Arkansas "oilstone" is no petrographic relative of the stone that was once quarried at a number of New England localities, and which was known as "Pikestone," or simply as whetstone. Pikestone, which was sometimes called novaculite, actually was a mica schist or a shale that contained myriad microscopic grains of sharp-edged quartz, and was used from the earliest New England days for honing scythes and other edged tools. To the modern geologist, the term "novaculite" has a special meaning. It refers only to the strange, dull-lustered, microcrystalline quartz rock that is found in this country as a rock type only in the Ouachita Mountains of Arkansas and Oklahoma, and in a small area of the Marathon region of west Texas.

BOOK REVIEWS

Gemstones of North America

By John Sinkankas. Princeton, New Jersey. 1959. D. Van Nostrand Co., Inc. 704 pages, 7½ x 10 inches. Richly illustrated with 9 color illustrations, 118 halftones, 68 line cuts. $15.00.

John Sinkankas, commander in the U. S. Navy, currently president of the Mineralogical Society of the District of Columbia and long-time contributor to publications of the amateur gem-cutting and rock and mineral fraternity, has produced a volume that we feel will be, despite a necessarily rather high price, a standard in its field. For the amateur who concerns himself strictly with gemstones and their localities on this continent, Commander Sinkankas has furnished a most comprehensive guide; and yet the common "rockhound" will find the book equally of interest, since many of the rare gemstones mentioned are also rare minerals. Many dashes of historical information and old-time photographs add greatly to the substance of this work. As to the competency of the author, we suggest the reader visit, when possible, the cut gem collection of the National Museum in Washington, D. C., where he will see displayed, among other treasures, an immense and flawless aquamarine, flawlessly cut by author John Sinkankas.

1001 Questions Answered About the Mineral Kingdom

By Richard M. Pearl. New York. 1959. Dodd, Mead & Co. 326 pages. Illustrated in black and white, with one color plate. $6.00.

Dr. Richard M. Pearl, associate professor of geology at the University of Colorado, needs little introduction to most serious amateurs in the fields of mineralogy and geology. This book, seventh in the publisher's *1001 Questions Answered* series, takes, as implied by title, the question-and-answer form. It avoids technical answers, but rather serves as a quick reference source for general questions of mineralogy, and some of geology. Included is a good bibliography and a comprehensive index; this latter being indispensible, of course, in a work of this sort.

This Sculptured Earth: The Landscape of America

By John A. Shimer. New York. 1959. The Columbia University Press. 255 pages. Illustrated with black and white photographs and drawings. $7.50.

The art of injecting human warmth into cold, scientific fact via the written word has flourished greatly in the past decade or so. John A. Shimer, an assistant professor of geology at Brooklyn College, has contributed handsomely to the art with *This Sculptured Earth*, in which he gently acquaints his readers with the geological processes responsible for the endless diversity of scenery to be enjoyed and interpreted in our country. The selection of photographs, as both art work and text supplement, is outstanding.

Bulletins

"Alexander Wilson—A Founder of Scientific Ornithology" is a 29-page pamphlet published by its author, Emerson Stringham, of Box 986, Kerrville, Texas, and is an essay on the life and work of that Scotch ornithologist of earlier days. It is priced at 50 cents, paper-covered.

"Indian Silverwork of the Southwest, Illustrated—Volume One," by the late Dr. Harry P. Mera, is a paper-covered volume of 122 pages that demonstrates, through the medium of pictures, the progress of evolution and developments in the famed silverwork of our Southwestern Indians. Much of the photographic material for this fine little publication was garnered from the Indian Arts Fund and the Laboratory of Anthropology in Santa Fe, New Mexico, and, with its explanatory panels, should be of great interest to students, fanciers, and wearers of Southwestern Indian silverwork. The price is $2.00, from Dale Stuart King, publisher, Globe, Arizona.

Park Bills Introduced

A bill to establish Great Basin National Park on 147,000 acres of the Wheeler Peak-Lehman Caves country of eastern Nevada, as outlined by the National Park Service, was introduced in both houses of Congress late in the first session of the 86th Congress. (For a comprehensive description of the proposed park area and its features, refer to *Nature Magazine* for June-July, 1958; *A Possible National Park*, by Weldon F. Heald). In the Senate, the bill was introduced by Senators Alan Bible and Howard Cannon, while a similar bill was introduced in the House by Rep. Walter S. Baring. All persons interested in the establishment of Great Basin National Park should, of course, make their sentiments known to their Congressmen.

"Old Stump-Rump"

It is remarkable what the loss of a few showy feathers, teeth, hair, or such, will do to deflate the ego of the loser.

We were out on the front porch one day—my two youngest, the neighbor kids, and myself—when a bluejay dropped down to the overhanging eave, and paused, with his tail feathers projecting beyond the edge. Quick as a flash, Tom, my young son, hopped to the ledge of the porch wall and grabbed the jay. The bird broke away, violently, leaving his tail-feathers in Tom's hand. I do not know which was the most surprised, the boy or the bird, but the bird was the most stunned, (and stumped, too, may I venture?) It dropped down to the ground where it made several clumsy attempts to fly, and finally managed to gain the lower branches of one of the big trees in front of the house, where it sat for a while gathering its wits and equilibrium. It finally managed both, and flew away.

After that we saw it occasionally, in the trees of the back yard, or those in front, but never did we hear a sound out of it. Gone was all the raucous cat-calling and kiyoodling; all the joyous bouncing on its spring shoes that is typical of the species. With the loss of his beautiful plumage went all of his braggadocio and assurance, and, also, his prestige, for he was henceforth known around the neighborhood as "Old Stump-Rump!"

DAGMAR CHRISTENSEN

Tikal

(*Continued from page 459*)

Hieroglyphs, decorative art and religious sculpture in stone and flint-hard sapodilla wood indicate that Tikal's major animal species are much the same today as they were a millennium ago. A striking example is the so-called "jaguar lintel" that spanned an inner doorway of Temple I, perched atop a pyramid in the Great Plaza. The carving in sapodilla depicts an enormous jaguar above a seated human figure. The lintel, removed to a Swiss museum in the nineteenth century, is memorialized in Temple I's popular name: "The Pyramid of the Giant Jaguar."

The significance of such symbols in the Mayas' theocratic society remains obscure. However, the Maya scholar Herbert J. Spinden observes: ". . .the human form had only a minor interest because the gods were not in the image of man and the art was religious. The gods were at best half human and half animal."

Reptilian associations were prominent in the Classic Mayas' spiritual symbolism. From the Western viewpoint, perhaps the most bizarre example is that of a human head emerging from the gaping mouth of a serpent. This conception, sculptured throughout the Classic and post-Classic areas, represents the serpent's innate human intelligence. The symbol seems to be uniquely Middle American.

Maya divinities that were zoomorphic, or partly so, included an old man with a spiral shell attached to his body, the bat, the jaguar and the screech owl. These animals, as well as the monkey, tapir, coatimundi and others that still roam Tikal, are commonly depicted in Maya art.

Further evidence of animal-oriented ritual comes from tombs and caches at Tikal and at Uaxactün, which the Carnegie Institution investigated, from 1926 to 1937. Mr. Shook, a member of the Uaxactún dig, recalls finding there ceremonially interred bones of puma, jaguar, ocelot and paca (a large rodent of the genus *Cumiculus*.) That they were not accidental burials is proved by the fact that some of the skulls were painted red. At Tikal, the Shook team has unearthed sting ray spines and sea shells, obviously brought in trade to the inland city.

No ritualistic explanation has been assigned to animal burials. But from a biological viewpoint, they may yield secrets of faunal changes. In inviting Tikal archeologists to use the Harvard museum's facilities, Dr. Paynter says: "In the past this museum has cooperated with the Peabody Museum of Archeology [at Harvard] and assisted in the identification of animal remains from Yucatan. We hope that we shall be able to assist the people at Tikal."

A visitor need be neither archeologist nor natural scientist to enjoy Tikal; a simple appreciation of Nature is enough. Any stroller is almost certain to see a family of coati, squirrels, deer and perhaps an armadillo or a long-snouted tapir, that largest of all tropical American land mammals. Jaguar and puma are there, too, but are wary and seen only fleetingly.

The monkey population, once heavy, was decimated by a yellow fever epidemic in August, 1957. But Mr. Shook was able to report this year that "the spider monkeys are coming back in larger numbers and we recently saw the first pair of howlers."

The *aguada* near Mr. Shook's bungalow is a gathering place for killdeer, sandpipers, kingfishers, herons and egrets. A six-foot crocodile, regarded by the camp as a pet, shares the stagnant pool with assorted turtles and frogs.

The ornithologist's delight is the handsome ocellated turkey indigenous to Yucatan. The glint of a sunbeam on the iridescent, bronze-colored plumage is as exciting to today's bird watcher as it must have been to the hungry Maya who stalked the bird with purely culinary intent.

In the early-morning sky a flock of parrots flies by overhead, beating the air with stubby wings. Hummingbirds of half a dozen bejeweled varieties alternately stand motionless before a blossom and dart off to another feeding spot. Keel-billed toucans dine querulously atop a palm, clacking that enormous beak of which an early naturalist observed: "It seems made for the purpose of swallowing bananas whole."

It is to enjoy such sights that many laymen, who come solely to inspect Mayan architecture, end up sauntering with less archeological purpose along the many shady jungle trails.

Wildlife Refuge

During the past summer, the government of Ecuador declared the Galapagos Islands—600 miles off the coast of Ecuador and home of a unique and historic flora and fauna—a national park and wildlife refuge. By government decree, the killing or capture of animal life of the island group is prohibited, bringing to a successful conclusion the efforts of many conservation workers and agencies the world over. It may be remembered that, as late as 1956, there was a movement on foot to publicize the Galapagos Islands as a tourist attraction and hunter's paradise, an eventuality that would have permanently sealed the fate of the remarkable assortment of animal life that played a large part in the speculations of Charles Darwin as to the evolution of life forms, speculations that eventually resulted in his celebrated statement on evolution as outlined in the *Origin of Species*. (*Nature Magazine* for October, 1957, published an article entitled *Challenge of the Galapagos*, by Irenaus Eibl-Eibesfeldt, biologist on the staff of the Max Planck Institute of Buldern, Germany, to which the reader may refer for details about these islands.)

Bulletin

"Food Habits of Migratory Ducks in Illinois," by Harry G. Anderson, is Vol. 27, Article 4 of the Illinois Natural History Survey, a 60-page bulletin presenting the results of a study of the eating habits of 17 species of wild ducks in Illinois. Purpose of the study was to correlate available plant and animal food supplies with their uses by these birds, and included is a tabulation and description of food items, many of which are illustrated. The pamphlet, price of which will be 50 cents after Nov. 1, 1959, is available from the Illinois Natural History Survey Division, Urbana, Illinois. Another publication from the same source is titled "Night-Lighting: A Technique for Capturing Birds and Mammals" (Biological Notes No. 40). During ecological and behavioral studies, it is sometimes necessary to capture large numbers of wild birds and mammals, a difficult task. Ronald F. Labisky, assistant wildlife specialist of the Survey Division, tells how this may be accomplished by night-lighting, and summarizes necessary equipment.

Trogons

(*Continued from page 468*)

her round hole began in a mass of brood cells screened in front by the loosely hanging, papery tissue of the torn outer envelope. The male elected to begin on a lateral face of the wasps' nest, at a somewhat higher point. Curiously enough, although the two were making separate holes, they worked alternately, as when trogons carve at the same hole. It apparently never occurred to them that they were spoiling the nest that it cost the over two weeks to capture. The male took the longer spells of work, up to twenty-one minutes continuously, and accordingly his hole deepened far more rapidly than that of his mate, whose turn at the nest was taken up with a number of short spells of activity, lasting from a few seconds to three minutes, with intervening periods of rest on neighboring perches. In their intervals of repose, both birds constantly uttered low, soft, melodious sounds.

The few remaining wasps did not display much spirit and rarely attacked the trogons. But sometimes they hovered about the head and shoulders of the female, whose shallower hole left her more exposed, and she turned back her head to snap at them. At times one would cling to her plumage, causing her to dart rapidly away, trying to shake or pluck off the insect, an endeavor in which she usually succeeded promptly. I could not tell whether the birds were ever stung; they gave no evidence of pain, and I noticed on their heads no swellings such as might have resulted from a sting. When I left this locality at the end of June, a full month after the birds began to catch the wasps, they still had not started to incubate; and I do not know whether the male's excavation or the female's was finally chosen for the eggs.

From Barro Colorado Island in the Panamá Canal Zone, violaceous trogons have been reported as excavating chambers in termite nests and incubating in a cavity in a low stump, both of which are sites frequently chosen for their nests by other species of trogons. Once, in southern Costa Rica, I watched some male violaceous trogons, who had been calling much in a tall tree at the forest's edge, drop down and cling for a few seconds at a time to a decayed portion of the trunk, as though interested in it as a nest site. But the four occupied nests that I have found in El General and lower parts of the Térraba Valley in Costa Rica, as also the four other nests at which I have watched sustained work, were all in silver-gray wasps' nests. These were situated far out on exposed branches of trees standing in pastures or plantations or at the forest's edge, never within the heavy rain-forest, at heights ranging from fifteen to about one hundred feet above the ground. In this region I have seen the trogons preparing nest cavities from mid-February to mid-June, while nestlings were present from late April to early June. In El General, the pleasant calls of the males are heard more or less throughout the year, but chiefly from late January to June.

Not long ago I met, for the first time in years, an owl in the forest near my house in El General. It was a spectacled owl, the largest of the local species, resting immobile high up in a tree. With its great head and massive form made still more impressive by puffed-out feathers, it seemed nearly as thick as long, and appeared huge by contrast with the smaller birds that had gathered around, protesting the strange presence. Chief among these were trogons and hummingbirds. Some of the latter hovered very close to the giant owl, seeming almost to touch it. The trogons preserved a more respectful distance but were loud in their complaints. A violaceous trogon made a sharp, rattling note while slowly raising his tail well above his back. A pair of white-tailed trogons scolded in lower tones, the male fanning out his tail feathers laterally with a quick motion instead of elevating them like the violaceous trogon. A male green honeycreeper flitted about quite close to the monster, who remained sleepily indifferent to the hubbub it was causing.

Calendula

(*Continued from page 488*)

All these lovers and eulogists of the charms of the marigold were inspired by the simple blossoms of their times. One wonders to what heights of eloquence they might have soared at sight of the present-day descendants of those primitive forms? There are varieties, too numerous to mention here, that are listed and described in the nurseryman's catalogs, together with instructions as to their culture in home gardens. The colors vary from palest yellow to deep orange, orange-red, and are even variegated in mixtures of yellows. The blossoms range from small daisylike forms to great ragged heads that compete with chrysanthemums in size and beauty. And the end is not yet!

Alphabet of Animals

From the South African Tourist Corporation, 610 Fifth Avenue, New York 20, N. Y., comes a most attractive 48-page, color-illustrated booklet with the title cited above. It pictures and describes forty-five native animals that the visitor to the Union of South Africa can readily see there. The booklet also describes the struggle to set aside Kruger National Park and other preserves to save for posterity both rare and common fauna of South Africa. In these 48 pages we have a guide to the animals and where to see them. A copy is available free.

Bulletins

"Maple" is the title of the 12-page pamphlet of the U. S. Forest Service dealing with the species and varieties of this tree to be found in the United States. Included are distribution maps, growth, supply and property sections, a tabulation of the principal uses of maple wood and maple products, and a bibliography. For sale by the Superintendent of Documents, Washington 25, D. C., for ten cents.

"Making Land Produce Useful Wildlife" is Farmers' Bulletin 2035 of the U. S. Department of Agriculture. A farm is a complex community, and farmers can have better farms and ranches by maintaining a good biological balance between the land and its wildlife. The purpose of this 30-page illustrated booklet is to outline wildlife requirements and explain the correct management of land to maintain such requirements. It is available from the Superintendent of Documents, Washington, D. C., for 25 cents.

"The Yellow Perch" is publication 228 of the Wisconsin Conservation Department, Madison 1, Wisconsin. Four department collaborators outline in detail the life history, ecology and management of this popular panfish, and include an extensive bibliography.

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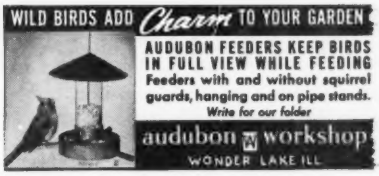
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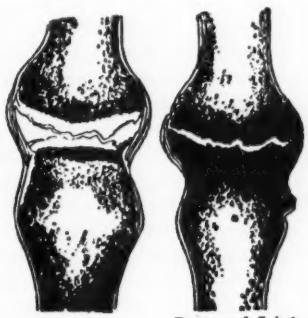
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Nature AND THE MICROSCOPE

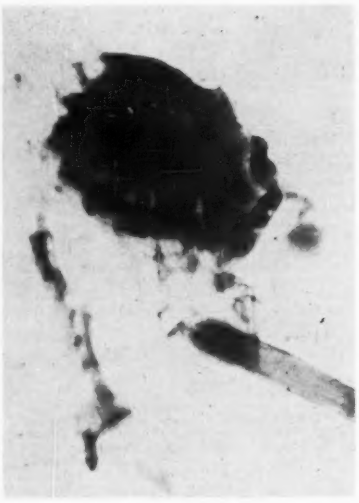
By JULIAN D. CORRINGTON

Man's Allies, the Spiders

THE AVERAGE PERSON REGARDS SPIDERS as second only to snakes among animals to be feared and avoided. But a search of the literature, both scientific and popular, will reveal that a surprisingly large number of investigators have made spiders the subject of their life work, or of a considerable segment thereof. A little study will disclose that this is one of the most fascinating of all animal groups to observe carefully, and that their dangerous properties are greatly overrated. Save for the members of two small families, all spiders are venomous, but the bite of even the largest poses no more of a threat to a creature as large as man than does a bee sting, while that of the great array of small species is negligible. The one exception in the United States is the notorious black widow, whose bite is serious and can be fatal.

As Comstock states, however, it does not necessarily follow that the poison which can kill a fly would harm a man; that spiders are very timid and try only to escape when approached or annoyed by man; and that of the thousands of specimens he has collected with his hands, not one has bitten him. Naturalists and biologists, who can approach a subject of this sort objectively, are unanimous in asserting that a fear of spiders is both groundless and senseless.

Spiders are among mankind's most potent allies in the ceaseless warfare on insects, for all spiders are carnivorous, adapted to suck the body fluids of their victims. Some are cannibalistic, but the major portion of their food is insects. They are hence of great economic value to man and have little indeed to be chalked up on the debit side of the ledger. Sometimes their webs may be annoying around the house, but they do not damage household goods and stores. In south Florida, the huge banana spider or giant crab spider, *Heteropoda venatoria*, is locally known as a "house spider," and is highly prized



Spider eyes, 28X, microtessar.

by all housewives who have lived long enough in the subtropics to learn of the habits of this interesting pet. It runs rapidly over walls and ceilings and is well-nigh impossible to capture without a net. One woman was moving her residence and refused to leave without her house spider, for they feed mainly on cockroaches, performing the same household service against these pests as the cat does in catching mice.

Adaptive spiders

Spiders exhibit some of the most remarkable adaptations to their varied environments and some of the most intriguing correlations between structure and behavior to be met with anywhere in the animal kingdom and, incidentally and because of their small average size, provide the microscopist with excellent and abundant material for his work with the microscope and slide preparations.

Our subjects belong to the Class Arachnoidea of the Phylum Arthropoda, of which phylum other classes include crustaceans, millipedes, centipedes, and insects. Other members of the Arachnoidea are the scorpions, some lesser-known groups as the pseudo-scorpions, the harvestmen, ticks and mites, and the horseshoe crab. Thus a spider is an animal, an arthropod, and an arachnid, but it is not an insect. Insects have three pairs of legs, spiders four pairs; an insect has three body regions—head, thorax, and abdomen—whereas in spiders the first two are fused to make a single region, the cephalothorax; spiders have no wings, insects commonly two pairs; insects generally undergo a metamorphosis in their life cycles, spiders do not, the young (spiderlings) resembling the parents; insects normally have both compound eyes and simple eyes (ocelli), spiders only ocelli. There are many other differences, including those of internal anatomy, but the foregoing will serve readily to distinguish the two classes.

The appendages of spiders are vastly interesting structures and enable their owners to perform many marvelous acts. All of them make excellent whole mounts for the slide collection, prepared with or without potashing, according to size and opacity. The first pair are the *chelicerae* or jaws, which are modified antennae, homologous with the second pair of antennae in crustaceans, but not with those of insects, which represent the first pair of crustacean appendages. Each chelicera is composed of two segments, a stout basal one and a more slender fang. In tarantulas these jaws work vertically, whereas in others (often called "true spiders"), the fangs are so disposed as to operate horizontally. The poison duct opens as a tiny pore just back of the tip of the fang.

Calamistrum on fourth metatarsus, 150X.

Spinnerets at end of abdomen, 28X, microtessar.

Next come the *pedipalps*, resembling legs, but composed of six segments, whereas the legs have seven. The basal piece of a pedipalp (leg-feeler) is the endite or coxa, the remaining five the palp. These are normally developed in females but modified in males to serve as an organ for transferring sperm to the female, an extraordinarily specialized adaptation. Each *leg* consists, from base outward, of coxa, trochanter, femur, patella, tibia, metatarsus, and tarsus. The pedipalp lacks the metatarsus; the patella is not represented in the insect leg, and in this group the tarsus is made up of several pieces.

Eyes of spiders

Spider eyes, rarely absent, number usually four pairs, sometimes three pairs. The most typical condition is that of eight eyes in two rows; the eyes are designated as anterior and posterior laterals and medians. In some forms these ocelli are disposed in more than two rows. There are two kinds, those with a pearly luster and those that are not pearly, but either clear or dark. Most spider eyes glow in the dark by reflected light, and are considered nocturnal eyes, but the differences are correlated with microstructure rather than with the outward coloration.

It is not generally known that some spiders can produce sounds. Two types of *stridulating organs* occur; in several tarantulas and in the sheet-web weavers these are located on the mouthparts; in the comb-footed spiders they are at the juncture of the thorax and abdomen. In each case they are composed of a file and scraper, but the sounds produced are minute as compared with those of stridulating insects, as the katydid.

High in interest concerning the external features of spiders are the *spinnerets* or organs for spinning silk. Generally there are three pairs, sometimes two or even only one pair. They are located ventrally at the end of the abdomen and resemble little fingers or spigots. Arachnids exude a secreted fluid from these spinnerets that hardens on contact with air and becomes a fine thread of silk, used by the spider for many purposes and by man as cross hairs in optical instruments. Webs of many types are known to everyone, the orb web, funnel web, sheet web, triangular web, or irregular cobweb in the corner of the living room ceiling; these are all classed as *snares* and are for the purpose of catching insects as food.

But in addition most spiders pay out a *dragline* as they go, fastening it at frequent intervals by an *attachment disc*, and it is from such an anchorage that a spider can drop down from a tree or fence rail, paying out its silken line as it goes. Females make *egg sacs* and males *sperm sacs* of their webbing; victims may be wrapped in *swathing bands*, to secure them from escape; and there are even great numbers of spiders who spin their silken strands into the atmosphere, from an elevated perch, and are then carried away in the act termed *ballooning* when enough silk has been emitted to float on the breeze. Spiders may be carried long distances in this way, for dispersal of the species. Some have been collected from airplanes flying at 5000 feet (Kaston), others from ships far out at sea.

Unique threads

In certain groups of spiders there is a special area above and between the spinnerets that looks like a sieve plate, punctured by numerous fine pores. This is the *cribellum*. From it issues a unique form of thread, the hackled band, and such spiders proceed to comb this thread by means of a device on the fourth metatarsus, the *calamistrum*. What special role this modified thread plays is not known.

Spiders occur everywhere. Kaston records that certain ones were taken as high as 22,000 feet on Mt. Everest, the greatest elevation at which any animal has ever been collected. Some skim over the surfaces of ponds and streams or dive beneath; *Argyroneta aquatica*, of Europe, makes a dome of silk among plants on the bottom of a pond, fills it with air that she carries down to it, and dwells there, feeding on aquatic insects. Others live in trees, on foliage of every sort, in rotting leaves and humus of the forest floor, under rocks and bark, in caves, and in all situations about the garden, home, or barn. Flower spiders mimic the coloration of the particular flowers on which they live, in order to pounce upon an unsuspecting insect visitor; *Cyclosa* is protected from predators by resembling bird dung. Jumping spiders progress by leaping; wolf spiders run about over the ground and actively pursue their prey; trapdoor spiders burrow, lining their retreat with silk and closing the opening with a silk-hinged lid.

Courtship dances

The courtship dances of these small animals have attracted numerous investigators. Sometimes the female eats her spouse after mating, but this cannibalistic act is not as frequent as formerly thought. The constructing of the more elaborate and perfect orb webs, as with garden spiders, has also engaged much scholarly attention, and the details are now thoroughly known. This act is considered to be one of the most elaborately developed instincts possessed by any form of animal life, and has been made the subject of countless studies—mechanical, ecological, psychological, and teleological.

The great and the near great have written about spiders. Atkinson, Nathan Banks, Blackwall, Sherman Bishop, Chamberlin, Comstock, Crosby, Emerton, Fabre, Latreille, Marx, Menge, Montgomery, the Peckhams, Petrunkevitch, Savory, Simon, Weed, and Wilder are some of the names of chief authorities in this area. Two of the best books for the average Nature student to consult or own, if it is felt that the subject merits further inquiry and that it might provide a most absorbing outdoor and indoor biological pursuit, are those by Comstock and the Kastons.

John Henry Comstock, famous

pioneer entomologist at Cornell, wrote *The Spider Book* in 1912, and filled a significant gap among natural history guides, but this book eventually went out of print. In 1948, it was revised and edited by W. J. Gertsch, of the American Museum of Natural History, and is again available from the Comstock Publishing Company at Ithaca, N. Y. In 1953, Benjamin J. and Elizabeth Kaston issued *How to Know the Spiders*, a member of the Pictured-Key nature series published by the William C. Brown Company, at Dubuque, Iowa. This is a handy, fully illustrated manual for identification, including many interesting facts about these strange, yet familiar animals.

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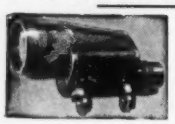

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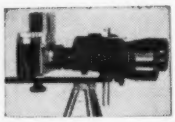

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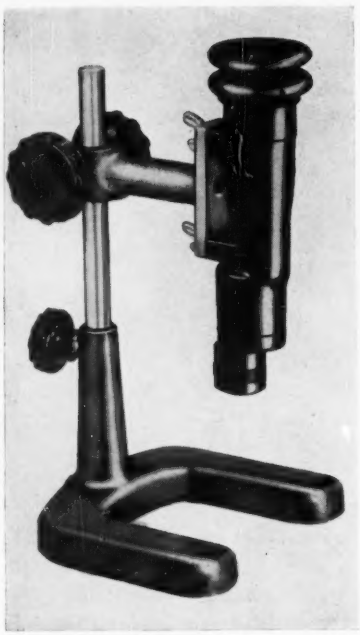

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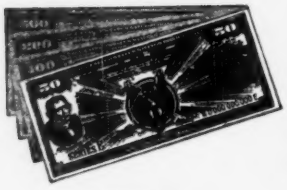

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